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THE UNITARY FIELD THEORY OF EINSTEIN AND ITS BEARING ON THE MACROSCOPIC ATOMIC THEORY*

WHEN Einstein, in the general theory of relativity, extended the principle of relativity so that it applied to non-Galileian as well as Galileian frames of reference and, thereby, established the fact that the metrical properties of molar space-time are conditioned, in part at least, by the gravitational field, several problems remained unsolved. Firstly, there was the question of the relation between the electro-magnetic and the gravitational field. Secondly, an adequate theory of measuring seemed to be lacking. Thirdly, the question of the relation between matter and space-time arose. And lastly, a problem of motion appeared.

The first problem was quite evident. The general theory necessitated the conclusion that the metrical properties of space are conditioned by the distribution of molar matter. This meant that the gravitational field and space had been brought within a single continuum. In fact, Einstein asserted that "gravitation occupies an exceptional position with regard to other forces, particularly the electromagnetic forces, since the ten functions representing the gravitational field at the same time determine the metrical

*Cf. "The Macroscopic Atomic Theory; A Physical Interpretation of the Theory of Relativity," *J. of Phil.*, XXV, pp. 449-467; also *Proc. National Academy of Science*, XVI, pp. 55-68.

properties of the space measured."[1] This left nature with a sharp gulf between the metrical-gravitational field and the electro-magnetic field. The artificiality of this situation was evident. Gravitational fields appear in the same regions through which electro-magnetic forces are transmitted, and are known to be associated with molar bodies which are built up, in part at least, out of the electrons and protons of electro-magnetic theory. Here was a dualism which empirical knowledge, as well as the desire for logical simplicity, urged the mind of man to remove.

The first person to develop a theory which provided this unification was Weyl.[2] In his theory the unique position, with reference to the determination of the metrical properties of space, which Einstein had assigned to the gravitational field, disappeared. Weyl's theory was generalized by Eddington to establish an interpretation of science which involved the reduction of all the physical categories of science, so far as relativity theory is concerned, to geometrical ones.[3] A few years later, Einstein rejected this development of his theory. He said, "Through many failures, I have arrived at the conclusion that one cannot come to the truth in this way."[4] His latest achievement[5] represents the positive part of this statement. It is the result of an attempt to achieve what Weyl realized, by different methods. The structure of the spatial, the gravitational, and the electro-magnetic field is revealed as a single structure of a single continuum.

Two points may be noted with reference to this aspect

[1] Translated from "Die Grundlage der allgemeinen Relativitätstheorie," *Annalen der Physik*, 49 (1916). *The Principle of Relativity*, Methuen, (1923), p. 120.

[2] *Cf.* "Gravitation und Elektricität," *Sitzungsberichte der Preussischen Akad. d. Wissenschaften*, 1918.

[3] *Cf.* A. S. Eddington, *Space, Time and Gravitation*, Cambridge, 1921, p. 197.

[4] *Math. Annalen*, 97, p. 99ff

[5] "Zur einheitlichen Feldtheorie," *Sitzb. d. Preuss. Acad. d. Wiss.*, Jan. 1929.

of the unitary field theory of Einstein. Firstly, it involves a rejection of his original thesis that gravitational fields alone determine the metrical structure of space. Secondly, unless it has greater fertility in providing secondary laws and consequences in the field of experimentation, there is no reason for preferring Einstein's solution to the one previously given by Weyl. Both accomplish the same purpose by providing science with a tensor equation in which the electro-magnetic as well as the gravitational potentials are contained.

It is when one considers Einstein's latest achievement in its relation to the second problem to which the general theory gave rise that its uniqueness and significance appears. This problem arose because it seemed difficult to provide an adequate basis for measuring if the geometry of the general theory were accepted. The first person to fully appreciate the reality and seriousness of this difficulty was Whitehead.[6] He pointed out that if space has the variable and heterogeneous structure which the general theory necessitates, then it is very difficult to understand how the measurements of distant spaces, which provide the basis for modern science, could ever have occurred.

An appreciation of the validity of this rather devastating comment calls for a consideration of what measuring requires, and what the geometry of the general theory provides, in the way of metrical properties.

Consider a local distance here on the earth. A determination of its length presents no problem. One takes a standard rod and notes how many times it must be layed down end to end in passing through the distance in question. In determining a distance in astronomical space, the task, however, is not so simple. It is impossible for the

[6] *Cf. The Principles of Natural Knowledge*, Cambridge, 1919, pp. 54 ff.; *The Concept of Nature*, Cambridge, 1920, Ch. VI.; *The Principle of Relativity*, Cambridge, 1922, Ch. III.

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scientist to travel with his measuring rod from the earth to the sun, and then go cruising out through space to Sirius moving his measuring rod along as he goes. Instead, certain equalities must be established between the astronomical distances which cannot be traversed, and the local terrestrial distances which can be so traversed. The establishment of these equalities necessitates a recourse to universal geometrical principles. Such universal geometrical principles cannot be safe guides for the establishment of a relationship of congruence between celestial and terrestrial distances unless they exist in nature in the form of a certain amount of uniformity and constancy in the metrical properties of space. Furthermore, these uniform metrical properties must extend over very great distances. In other words, it is only by combining universal geometrical principles, which presuppose a certain constant uniformity in the metrical properties of space, with the values for local distances, that we can talk with verifiable meaning about astronomical distances at all.

Nevertheless, the general theory of relativity left science with a theory of space in which no such basis for uniformity could be expected to exist. This becomes clear if one remembers that the general theory contains two parts: firstly, a single law of motion, which asserts that a body follows a path which is a geodesic in four-dimensional Riemannian space-time; and secondly, the tensor equation for gravitation which specifies how the distribution of gravitational potentials, or in other words, the distribution of matter, determines the metrical structure of space, and hence, the lay of the geodesic of a given body in a given region. The geodetic principle states the law of motion in geometrical terms; the tensor equation, however, immediately reduces the geometry to physics, by making the geodesic for a given region, and hence, the

metrical properties of space for that region, dependent upon the distribution of matter. This means, when matter rearranges itself, that space must take on different metrical properties. Since there is nothing in traditional physical theory to warrant the conclusion that matter must preserve a certain uniform and constant relatedness during all its motion, it becomes evident that the general theory, in the form in which it came originally from Einstein, leaves us with a universe in which the measurement of astronomical distances should be impossible. In other words, it leaves us with a universe in which the mechanics of Newton and Einstein could never have come into existence.

Is it any wonder that Whitehead wrote as follows: "I cannot understand what meaning can be assigned to the distance of the sun from Sirius if the very nature of space depends upon casual intervening objects which we know nothing about. Unless we start with some knowledge of a systematically related structure of space-time we are dependent upon the contingent relations of bodies which we have not examined and cannot prejudge."[7]

This point can be stated in geometrical terms. The measurement of astronomical distances requires the establishment of equalities between astronomical and terrestial distances. As we have indicated, these equalities can be established only by an appeal to geometrical principles. These principles must provide, among other things, a meaning for distant parallelism. The geometry of the general theory of Einstein provides a meaning for parallel displacement only over infinitely short distances. The same is true of the generalizations of Weyl[8] and Eddington.[9] This follows because the only type of parallelism which it pro-

[7] *The Principle of Relativity*, Cambridge, 1922, pp. 58-59.

[8] *Cf. The Principle of Relativity—Einstein and Others*, Methuen, 1923. p. 203.

[9] *Cf. The Mathematical Theory of Relativity*, Second Ed., Cambridge, 1924, p. 213.

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vided is Euclidean; and space takes on Euclidean properties in a Riemannian geometry only at a point, or, in other words, only over regions of infinitely short extension.

The significance of this can be made explicit by referring to certain recent statements of Einstein. In speaking of the Riemannian geometry of the general theory he writes: "Now consider two neighboring points PQ on the (Riemannian) surface and a little way off another pair of points P'Q'. What does it mean to say that the distance PQ is equal to the distance P'Q'? This statement only has a clear meaning when we have a small measuring rod which we can take from one pair of points to the other and if the result of the comparison is independent of the particular measuring rod selected.[10] It is evident, however, that we cannot take a measuring rod from a tract here on the earth to the tract which joins the sun to Sirius. If this is the end of one's theory of measurement then the determination of astronomical distances should be an impossibility.

Another statement by Einstein made in the same paper is relevant. It reads: "Consider a two dimensional Riemannian space in the form of a hen's egg. . . . it has a perfectly definite meaning to speak of the distance of two neighboring points PQ on the surface. Similarly, it has, of course, a meaning to say of two such pairs of points (PQ) (P'Q'), at separate parts of the egg, that the distance PQ is equal to the distance P'Q'. On the other hand, it is impossible now to compare the direction PQ and the direction P'Q'. In particular it is meaningless to demand that P'Q' shall be chosen parallel to PQ."[10] It is to be emphasized, however, that it is permissible to talk, even about the equality of the two lengths in question, in terms of determinable values, only in those cases in which a

[10] Albert Einstein, "A Simplified Discussion of 'Field Theories, Old and New'," N. Y. Times, Feb. 3, 1929.

scientist is able to apply a measuring rod directly to both of them. If PQ is a terrestrial distance and P′Q′ a celestial one, this is impossible. The latter astronomical type of distance can only be measured by establishing a relationship of equality between it and a terrestrial distance, by use of geometrical principles which involve, directly or indirectly, the notion of distant parallelism. Since the geometry of the general theory provided no meaning for distant parallelism, it follows that it left science with a theory of nature in which measuring is an impossibility and its own existence an absurdity.

The first attempt at a solution of this difficulty was offered by Whitehead.[11] He concluded that the doctrine of the heterogeneous character of space, of the general theory, left the physical theory of nature without an adequate account of the uniformity presupposed in measuring; and argued that it necessitates the rearing of science upon new philosophical foundations. He turned, therefore, to a reexamination of immediate experience in order to determine the original basis of our scientific conceptions. The result of this analysis, when supplemented by the deliverance of the Michelson-Morley experiment, was a conception of nature in terms of a vast extensive enduring process which he termed an "event." It is by abstractions from this monistic extensive occurrence that all our scientific concepts are derived. The first and most fundamental abstraction consists in the assignment of different parts of this total event to different classes by means of the relation of simultaneity. The relativity of time-systems arises from the Michelson-Morley experiment, and the fact that the passage of nature is too complex to insure that this assignment must be made by all observers in the same way.

In each time-system the complex of events exhibits two

[11] *Cf. The Concept of Nature*, Cambridge, 1920, Ch. III ff.

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main attributes: firstly, a certain constant uniform structure, termed space, joining the parts, or smaller events, together; and secondly, many adjectival permanences, such as the objects of sense, which produce the content that appears within this structure. Since there is a meaning for space only in a given time-system, a basis is provided for the relativity of space; and since the structure of space in a given time-system is constant, and is independent of the adjectival permanences which make up what we call molar matter, it follows that the uniformity and constancy necessary for measuring, exists, notwithstanding the changing relations of objects. This enabled him to write that "If" the metrical structure of space "be a relatedness between events, it has the character of a systematic uniform relatedness between events which is independent of the contingent adjectives of events."[12] Thus a theory is attained in which the relativity of space and time can be accepted without unsolving the problem of measuring.

It is to be noted, however, that Whitehead's solution comes at a terrific cost. It is necessary for him to deny the validity of Einstein's general theory.[12] This follows because the independence of matter from space-time structure, which his theory entails, necessitates the rejection of the thesis that the metrical properties of space are conditioned by matter. To deny this is to reject the Einsteinian law for motion and Einstein's tensor equation of gravitation. The reason for this decision, however, can be appreciated. Whitehead preferred an adequate theory of measuring to a law for gravitation which left science with a theory of space that made the measurement of astronomical distances impossible.

It seemed evident to the writer, however, that Whitehead's solution was not entirely satisfactory, notwith-

[12] *The Principle of Relativity*, Cambridge, 1922, p. 58.

standing the validity of his criticism, and the inadequacy in the geometry of Einstein's general theory, which gave rise to it. Although it provided a basis for measuring and a meaning for motion in a given time-system, the rejection of the dependence of space-time upon matter, which the general theory established, did not seem to be justified. Firstly, the extension of the principle of relativity to non-Galileian frames of reference seems to be a natural, if not a positively necessary, consequence of the special theory. Secondly, the experimental evidence for the general theory has been questioned less than the experimental evidence for the special theory upon which Whitehead's interpretation rests. It is to be noted that it is difficult to get the principle of the relativity of time-systems from a philosophical analysis of the extensive characteristics of nature. It is necessary to appeal to the Michelson-Morley experiment to establish this fundamental principle in Whitehead's theory.[13] It seems to be an unwarranted choice, therefore, to insist upon adjusting one's theory to experimental evidence in the case of the special theory, and to refuse to do so in connection with the general theory. The facts seem to indicate that the metrical properties of space-time are conditioned by the distribution of matter, as the experimental evidence for the general theory indicates, and that the uniformity necessary for measuring, for which Whitehead argues, also exists.

Is there any reason why this should not be the case? In other words, is it necessary to choose between Einstein's doctrine that matter conditions the metrical structure of space-time, and Whitehead's doctrine that the measuring of science presupposes the existence of uniform metrical properties over great finite distances in space?

In 1928 the writer pointed out[14] that these two theses

[13] *Cf. The Concept of Nature*, Cambridge, 1920, p. 85.
[14] *Cf. The Journal of Philosophy*, XXV, pp. 459, 464, 465.

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are incompatible only if one assumes the traditional theory of matter, and that the logical conclusion to draw, when one finds uniform constant metrical properties to be necessary for measuring, and yet dependent upon the distribution of matter, is that matter has a greater capacity to produce uniform relatedness than our traditional theory of matter would suggest.

From this, two consequences follow. Firstly, our traditional theory must be amended so as to provide us with a set of physical entities which can give rise to the general uniformity which is at the basis of astronomical measuring while also permitting the variable potential distribution which the general theory requires. Secondly, an analysis of the theory of relativity, which traces it back step by step, through its concrete connections with nature, to the principles at the basis of natural phenomena which it implies, should indicate what this new theory of matter is. This analysis was carried out with positive results, and published in August, 1928, in a paper[15] entitled "The Macroscopic Atomic Theory: A Physical Interpretation of the Theory of Relativity."

This analysis led to the conclusion that nature is atomic in character, and that the discontinuity which motion and atomism involve, as well as the uniformity which measuring requires, necessitate an amendment to the traditional atomic theory.[15] This amendment calls, as a very minimum, for the existence of a huge perfectly spherical finite physical atom which is hollow in its center except for its inner field. This single macroscopic atom contains and, because of its physical properties and finiteness, congests in its interior, all the microscopic particles of the whole of nature. It also provides the referent, in addition to the

[15] *The Journal of Philosophy*, Vol. XXV. pp. 463, 464, 465. See this paper for details and evidence.

electrons and protons, without which discontinuity and atomic motion cannot be given meaning. Thereby it solves the problem of motion to which the general theory gave rise.[16] Its fixed spherical form and congesting influence insure that the universe must exhibit, on the mean molar level in which we live, a relatedness or molar space-time structure which is a union of the contingent relatedness to which the motion of the microscopic particles gives rise, and the constant uniform relatedness which its own spherical form and congesting force is imposing.[17] As was indicated in the original paper, such an entity necessitates a union of the electro-magnetic and gravitational field with molar space-time,[18] and also places variability and uniformity in precisely those regions in nature where the general theory and the fact of successful astronomical measurements indicate that they exist.

This means two things with reference to the geometry of this universe. Firstly, it must be Riemannian. Otherwise, the variable potential distribution in local regions, to which the motion of the microscopic particles gives rise, as they compound to form molar bodies and molar motion, could not exist. Secondly, it must provide a meaning for metrical uniformity and constancy over great finite distances. Otherwise the macroscopic uniformity, which the macroscopic atom is imposing upon the contingent relatedness of the moving electrons and protons, would be equally non-existent.

It is hardly necessary to add that this is precisely the kind of geometry which Einstein has discovered in connection with his recent unification of the gravitational and electro-magnetic field. He writes: "The unitary field

[16] *Cf. ibid.*, p. 460.
[17] *Cf. ibid.*, pp. 471 ff.
[18] *Cf. ibid.*, pp. 455, 462 ff.

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theory is based on the following mathematical discovery: There are continua with a Riemannian metric and distant parallelism which nevertheless are not Euclidean."[19] In other words, a geometry actually exists and has been explicitly formulated in mathematical terms, which possesses the peculiar combination of local variability and macroscopic uniformity in its metric, which the macroscopic atomic theory introduced in order to reconcile Einstein's original doctrine of the dependence of space upon matter, with Whitehead's doctrine of the necessity of metrical uniformity for measuring. Furthermore, as the macroscopic atomic theory suggested,[20] this geometry actually exhibits itself, upon the molar level of this universe, in the gravitational-electro-magnetic field.

A recourse to mathematical symbolism renders this point precise. In a recent article[21] Eddington has stated Einstein's unitary field theory in terms of the same mathematical symbols as were used in Eddington's formulation of the traditional affine geometry. This makes possible an immediate comparison of the metrical properties of the two systems.

The affine geometry of Weyl and Eddington rested upon the equation

$$\frac{\partial A^{\mu}}{\partial x_{\sigma}} + \Gamma^{\mu}_{\epsilon\sigma} A^{\epsilon} = 0 \qquad (1)$$

This was restricted by making

$$\Gamma^{\mu}_{\epsilon\sigma} = \Gamma^{\mu}_{\sigma\epsilon} \qquad (2)$$

The significance of equation (1) is that it provides the metrical uniformity sufficient to indicate when two separate lengths are equal and parallel. Equation (2) insures that the parallelogram law holds, i. e. lines joining the ends

[19] *Cf.* "A Simplified Discussion of 'Field Theories, Old and New'," N. Y. Times, Feb. 3, 1929.

[20] *Cf. The Journal of Philosophy,* XXV, pp. 455, 462.

[21] *Cf. Nature,* Vol. 123, p. 280.

of equal and parallel lengths are equal and parallel. It is necessary, however, to introduce metrical variability if space-time is to provide an expression for the potential distribution of gravitational and electro-magnetic fields. Since the two equations given above prescribe complete metrical uniformity, it is necessary to regard them as applying only over infinitely small regions and to locate the variability in the macroscopic connections which unite these microscopic uniformities. This is accomplished by regarding equation (1) as non-integrable and by introducing a curvature tensor ${}^*B^{\epsilon}_{\mu\nu\sigma}$. Thus the traditional geometry of space-time located metrical uniformity in the infinitely small, and metrical variability in the macroscopically large regions of space.

The new geometry of Einstein exactly reverses this relationship. Equation (1) is accepted and regarded as integrable, thereby insuring a meaning for parallel displacement over any finite distance. The metrical variability, necessary for a unification of the spatial, gravitational and electro-magnetic fields, is attained by rejecting equation (2) for the equation

$$\Gamma_{\epsilon\sigma}^{\mu} = -h_{\epsilon}^{\alpha}(\partial h_{\alpha}^{\mu}/\partial x_{\sigma}), \qquad (3)$$

in which h_{α}^{μ} represents the quantities which are identified with the gravitational and electro-magnetic potentials at a given point. It is equation (3) which necessitates that the parallelogram law does not hold in the new geometry. The limitation which equation (1) places on equation (3) means that regardless of the local metrical variability, which gravitational and electro-magnetic potentials may introduce from point to point, sufficient metrical uniformity remains constant over macroscopic distances to provide a meaning for equal and parallel lengths. In other words, variation in the metrical structure of nature is a local

character and uniformity a macroscopic character of nature, as the macroscopic atomic theory indicated. At least, the type of metric which the latter theory necessitates is not incompatible with the demands of gravitational and electro-magnetic theory.

Since the macroscopic atomic theory was discovered and formulated independently of and previous to Einstein's latest achievement, it may be maintained therefore that his unitary field theory constitutes an additional argument for the macroscopic atomic theory. In fact, it is very difficult to understand how the metrical uniformity involved in distant parallelism can exist in a universe in which the metric of space-time is conditioned by the motion and distribution of matter, unless the macroscopic atom exists to offset the general contingent relatedness to which the motion of the microscopic particles gives rise.

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PHILOSOPHY AND EMBRYOLOGY: PROLEGOMENA TO A QUANTITATIVE SCIENCE OF DEVELOPMENT (II)

5. *Dynamic Teleology as an Occasion of Falling.*

IF, then, Bacon and his successors were right in banishing the concept of teleology from scientific thought, the quantitative, chemical, or exact embryologist need not be alarmed by the finalistic phenomena which, according to Rignano, interpenetrate the whole of ontogenetic development. In fact, it is not the phenomenon, but only one way of looking at it, that is finalistic, and it is this aspect of it that must be neglected in scientific work if the gravest confusion is to be avoided. Is there need for the biologist to be any more afraid of the Drieschian entelechy making what might be into what is and directing from within the development of the embryo in the egg or the uterus? The word "entelechy" as used by Aristotle meant that which exists in the highest sense of the word, whether actually or potentially, e. g., the sword in the mind of the swordmaker before a single one of the necessary operations of manufacture had been begun. The entelechy therefore operated on the process in question by means of the final cause, and did not reside in the changing entity if it was dead like the sword, though it did if it was alive like the embryo. Driesch frequently says that he uses the word in a quite different sense from Aristotle, but the majority of his

readers find it impossible to discover any essential point of divergence. He does at any rate make it much more precise than Aristotle, for he defines it as a non-spatial element in the living being, which at one time suspends possible action and at another time relaxes such suspension, acting in this way as the bearer of "individualising causality" and bringing the animal from potentiality into actuality.

It seems that this inherent immanent formative power has been translated by biologists of every period since Aristotle into the language of their time. Just as Driesch now tries to acclimatise it to the unfavourable environment of a post-Cartesian world, so St. Gregory of Nyssa, about 370 A. D., clothed it in the terminology of patristic times, and enunciated a theological variety of neo-vitalism. His most important biological works, *On the Making of Man,* and *On the Soul,* contain such passages as these, "The thing so implanted by the male in the female is fashioned into the different varieties of limbs and interior organs, not by the importation of any other power from without, but by the power which resides in it transforming it." And elsewhere, "For just as a man when perfectly developed has a soul of a specific nature, so at the fount and origin of his life, he shows in himself that conformation of soul which is suitable for his need in its preparing for itself its peculiarly fit dwelling-place by means of the matter implanted in the maternal body, for we do not suppose it possible that the soul is adapted to a strange building, just as it is not possible that a certain seal should agree with a different impression made in wax."

Thus the soul makes its body as if it were a gem making a stamp upon some soft substance, and acting during embryogeny from within—a conception essentially like that of Driesch. Many Renaissance authors adopted similar

views, e. g. Thomas Fienus. "No unsouled thing," says Gregory, "has the power to move and to grow. Yet there is no doubt that the embryo moves and waxes big as it is fed in the body of the mother." There is thus nothing new about Dynamic teleology; it is by no means the outcome of newly ascertained facts. It recurs from time to time in the history of biological thought because it is the natural result of an unscientific attitude.

I do not propose to discuss here the facts which originally led Driesch to the views expressed in his *Science and Philosophy of the Organism,* for they are very well-known, and have been shown by Jenkinson, Jennings, Warren, and Boveri, among others, to be interpretable on quite other lines. The mechanical view which has shown itself equal to providing working hypotheses for so many "irreducible and stubborn" facts already can deal unaided with the phenomenon of totipotence. Nor shall I demonstrate by a comparison of passages from Driesch and Paracelsus how closely the conception of immanent formative force or entelechy approaches the master-archaeus of Paracelsus and the later iatro-chemists such as Stahl, though this could easily be done, and Driesch has, in fact, to a large extent done it himself in his *History and Theory of Vitalism.* One may legitimately infer from this that the Drieschian entelechy has been and will be no more use as a practical working hypothesis for the laboratory than the archaeus was in the past.

Driesch's Dynamic teleology is open to much more serious and more fundamental objections. These were not obvious at the first appearance of his Gifford Lectures, but were clearly brought to light through the controversy which Jacques Loeb had with H. S. Jennings concerning tropisms. Loeb's theory entirely dispensed with any psychological factors, but Jennings upheld the view that they

might be legitimately brought into scientific discussion, provided they were regarded as being determined as well as determining. He considered that the pursuance of laboratory work demands as its minimum of system what he called Radical Experimental Determinism, and that there was difference of opinion as to whether this might regard conscious or unconscious mental processes as links in the chain of determinate causation. On this point Jennings and Loeb were antagonists, but both were united against Driesch, from whose writings it now appeared that psychical events might or might not affect physical events according to circumstances, and that the entelechy was subject to no general laws. Neal had maintained that the experimentally discoverable perceptual determiners in living things were insufficient to account for the effects produced in them. Jennings pointed out that, if this meant that the non-perceptual (mental) determiners acted supplementarily to the others and not instead of them, it was compatible with radical experimental determinism. But if it was said that some of the determiners were non-perceptual and could not be known at all, then it was incompatible. Now it was just this that Driesch had been saying. "A complete knowledge," he wrote, "of all physicochemical things and relations (including possible relations) of a given system at a given time does not give a complete characterisation of that system if it is a living system." He modified this as follows, "Practically we may say that complete knowledge of the physicochemical constitution of a given egg in a given state and of the behaviour following this constitution in one case, implies the same knowledge for other cases (in the same species) with great probability. But this is a probability in principle and can never be more. It would not even be a probability if we did not know the origin of a given egg

in a given state, i.e. that the egg was the egg, say, of an ascidian. But to know this history or origin is, of course, already more than simply to know its physicochemical constitution and its consequences in one case, which suffices in the realm of the inorganic. It may be that the eggs of echinoidea, fishes, and birds, are the same in all the essentials of physico-chemical constitution. Something very different happens in each case on account of the different entelechies. In spite of this we know with great probability what will happen from one case if we know that this egg comes from a bird and that from an echinoid. Therefore, practically, experimental indeterminism is not a great danger for science."

But the matter was taken up by various writers, and Lovejoy, especially, defended Driesch from the charge of interfering with the fundamental necessities of scientific thought. Jennings, however, was able to publish in reply letters from Driesch in which these implications of his position were fully admitted. "Two systems absolutely identical in every physico-chemical respect may behave differently under absolutely identical conditions if the systems are living systems. For the specificity of a certain entelechy is among the complete characteristics of a living organism and about this entelechy knowledge of physico-chemical things and relations teaches absolutely nothing." It was generally felt after this that if Driesch was right biologists might as well sell their farms and go to sea in despair.

In this connection it is interesting to recall the vivid account given by Claude Bernard of the polemic he had with Gerdy at the Philomathic Society in Paris, for the Driesch-Lovejoy-Jennings controversy simply repeated on a larger scale the arguments of the two Parisian biologists

sixty years before. "In 1859," says Claude Bernard, "I made a report to the Philomathic Society in which I discussed the experiments of Brodie and Majendie on ligature of the bile-duct, and I showed that the divergent results which the two experimentalists reached depended on the fact that one operated only on dogs and tied only the bile-duct, while the other operated only on cats, and, without suspecting it, included in his ligature both the bile-duct and a pancreatic duct. Thus I showed the difference in the results they reached and concluded that in physiology as everywhere else experiments are rigorous and give identical results wherever we operate in exactly similar conditions. A propos of this a member of the Society took the floor to attack my conclusions; it was Gerdy, a surgeon at the Charité, professor in the faculty of medicine and known through various works in surgery and physiology. 'Your anatomical explanation of these experiments,' said he, 'is correct, but I cannot accept your general conclusions. You say, in fact, that the results of experiments in physiology are identical; I deny it. Your conclusion would be correct for inert nature but cannot be true for living nature. Whenever life enters into phenomena,' he went on, 'conditions may be as similar as we please, the results may still be different.' To support his opinion Gerdy cited cases of individuals with the same disease, to whom he had given the same drugs with different results. He also recalled cases of like operations for the same disease, but followed by cure in one case and death in another. These differences, according to him, all depended on life itself altering the results, though the experimental conditions were the same, but this could not happen, he thought, in the phenomena of inert bodies, where life does not enter. Opposition to these ideas was prompt and gen-

eral in the Philomathic Society. Everyone pointed out to Gerdy that his opinions were nothing less than a denial of biological science, but he would not give up his ideas and entrenched himself behind the word 'vitality.' He could not be made to understand that it was only a word, devoid of meaning and corresponding to nothing, and that saying that something was due to vitality amounted to calling it unknown." Is the entelechy which confers on embryonic development the character of a personally conducted tour any different in nature from the vitality which interfered with Gerdy's pharmacological experiments?

Driesch and Rignano, then, agree in emphasising the teleological aspect of living beings, especially as exemplified in their embryonic development, but they differ in that Driesch gives up apparently all hope of causal explanation in ontogenesis, while Rignano, postulating no clearly defined entelechy, relies on the notion of a special variety of energy, something like the biotic energy of Benjamin Moore or T. P. Nunn, as the carrier of the special purposive aspects of life. This truly uncalled-for assumption leads Rignano into a series of singularly complicated hypotheses, such as the law of specific accumulation, and the centro-epigenetic theory, which cannot be discussed in detail here. It may be mentioned, however, that they involve the old-fashioned conception of "biogen" or living molecules, long ago given up by biochemists, (surely, in this case, the best judges) and provided with a funeral oration by Hopkins in 1913.

The Finalist and Dynamic-teleological schools would do well to study the thought of Claude Bernard more closely. Bernard was so subtle a thinker that it has always been a point of great difficulty to classify him with any of the main currents of biological thought, and, while Dastre

has claimed him as a mechanist, Driesch has delineated him as an exponent of Dynamic teleology. But the following passage seems to me to sum up as well as any other the main shape of his ideas. "When a chicken develops in an egg," said he, "the formation of the animal body as a grouping of chemical elements is not what essentially distinguishes the vital force. This grouping takes place only according to laws which govern the physico-chemical properties of matter; but the guiding idea of the vital evolution is essentially of the domain of life and belongs neither to chemistry nor to physics nor to anything else. In every living germ is a creative idea which develops and exhibits itself through organization. As long as a living being persists it remains under the influence of this same creative vital force, and death comes when it can no longer express itself; here, as everywhere, everything is derived from the idea which alone creates and guides; physico-chemical means of expression are common to all natural phenomena and remain mingled pell mell, like the letters of the alphabet in a box, till a force goes to fetch them to express the most varied thoughts and mechanisms. This same vital idea preserves beings by reconstructing the vital parts disorganised by exercise or destroyed by accident or disease. To the physico-chemical condition of this primal development, then, we must always refer our explanation of life, whether in the normal or pathological state." Here Bernard seems to recognise the significance of universal teleology, for he says, "here, as everywhere, everything is derived, etc." and at the same time he lays stress on the identification of the physico-chemical aspect with the scientific aspect, going on, indeed, to say that "physiologists can only act indirectly through animal physico-chemistry, i.e. physics and chemistry worked out in the field of life, where the necessary conditions of all

living organisms develop, create, and support each other according to a definite idea and obedient to rigorous determinism." It is true that elsewhere he identifies this "force that goes to arrange the letters of the alphabet" with the "mediating nature" of Hippocrates and the *archaeus faber* of Van Helmont. Had he read more in Lucretius than in Aristotle, he might rather have identified it with the necessary outcome of the constitution of matter, a suggestion more profoundly in harmony, perhaps, with the natural bent of the scientific consciousness, (*Cf.* Bacon's remarks on Democritus in *De Augmentis Scientiarum*). But, even so, he evidently regards it as the subject-matter of metaphysics and not of science, for he says in the next paragraph, "The term 'vital properties' is only provisional because we call properties 'vital' which we have not yet been able to reduce to physico-chemical terms, though doubtless we shall succeed in that some day."

6. *The Rock of Offence, Organicism*

By making use of the thought of Bernard, we pass by an imperceptible transition from Finalism and Dynamic teleology to Organicism, another of the principal forms in which the opposition to exact biology appears. This, like some of the other doctrines I have mentioned, has a long history behind it. The notion, "We murder to dissect," finds clear expression as early as 200 A. D., when Q. Septimius Tertullianus of Carthage, one of the Western Fathers, spoke thus of Herophilus, the Alexandrian anatomist: "Herophilus, the physician, or rather butcher, dissected 600 persons that he might scrutinise nature, he hated man that he might gain knowledge. I know not whether he explored clearly all the internal parts of man for death itself changes them from their state when alive,

and death in his hands was not simply death, *but led to error from the very process of cutting up.*" No more excellent statement of the organicistic viewpoint could be devised. Sir Kenelm Digby in 1644 gave an even clearer summary of this point of view, and even in the rationalistic eighteenth century there were scientific men who insisted that the living being was an organism. Cuvier took a very definite stand on this question when he said, "All the parts of a body are inter-related, they can act only in so far as they all act together; trying to separate one from the whole means transferring it to the realm of dead substance and entirely changing its essence." But the name most familiarly associated with biological organicism in this country is that of J. S. Haldane, who has frequently set forth his views upon this subject. His attitude is so well known that it need not be described here. The living animal, he holds, is a constellation with a far higher degree of internal relatedness than any non-living system; the organic, in fact, cannot be understood by a study of its parts though the inorganic very possibly can. In other words, an organism is an entity whose parts lose all their characteristic properties when they are studied away from the organism itself; they fall, as it were, into meaninglessness, as soon as they are abstracted from the whole of which they are parts. Consequently that kind of biophysics, and *a fortiori* biophysical embryology, which analyses living organisms, is unsatisfactory as an apparatus for understanding living things and should give place to studies in which organisms are regarded intact. Moreover, it is only in the untouched organism that those wonderfully well-balanced actions are seen by which the animal or plant holds to its own niche in the economy of nature, resisting every attempt to dislodge it, provided the attempt be not so successful as to disorganise the living thing. This power of

maintaining a constancy in its external and internal environment is what Haldane regards as the *deus ex machina,* the property of living things essentially inexplicable by physico-chemical hypotheses and requiring special biological language for its formulation. "All attempts," he says, "to trace the ultimate mechanism of life must be given up as meaningless. The aim of biology becomes a very different one—to trace in increasing detail, and with increasing clearness, the organic determination which the organic conception formulates." Another aspect of Haldane's teaching was the view that the living animal was in some way more real than the world of physics; physics and biology, he thought, might some day coalesce, but it would then be found that physics would not have swallowed up biology; rather the contrary would occur and biology would swallow up physics. "The idea of life," he said, "is nearer to reality than the ideas of matter and energy, and therefore the presupposition of ideal biology is that inorganic can ultimately be resolved into organic phenomena, and that the physical world is thus only the appearance of a deeper reality which is as yet hidden from our distinct vision and can only be seen dimly with the eye of scientific faith."

There had been precursory voices of all this in the nineteenth century, as when, in spite of the discoveries of Cagniard de Latour and others that the yeast-cell played an essential part in fermentation, Justus von Liebig refused to credit them, fearing that their suggestions were a return to explanations by vital force. "Chemical actions may very well explain physiological actions, but certainly not *vice versa,*" said Moritz Traube. Claude Bernard, moreover, discussed the matter with his usual subtlety. "Physiologists," he said, "must not forget that a living being is an organism with its own individuality. Since physicists and chemists cannot take their stand outside the

universe they study bodies and phenomena in themselves and separately without necessarily having to connect them with nature as a whole. Physiologists, on the contrary, find themselves outside the animal organism which they see as a whole, even when trying to get inside so as to understand the mechanism of every part. The result is that physicists and chemists reject all idea of final causes for the facts which they observe while physiologists are inclined to acknowledge an harmonious and pre-established unity in an organised body, all of whose actions are independent and mutually generative. If we break up an organism for the sake of studying its parts it is only for the sake of ease in experimental analysis, and by no means in order to conceive them separately. Indeed, when we wish to ascribe to a physiological quality its value and true significance we must always refer it to this whole and draw our final conclusions only in relation to its effect on the whole. It is doubtless because he felt this necessary interdependence among the parts of an organism that Cuvier said that experimentation was not applicable to living beings since it separated organized parts that should remain united. For the same reason vitalists proscribe experiments in medicine. These views, which have their correct side are nevertheless false in their general outcome and have greatly hampered the progress of science." Bernard did not commit himself to an absolutely unambiguous statement as to the correct and incorrect side of organicism, and seems to have regarded it as only true in the sense that imaginative synthesis should follow radical experimental analysis. He was therefore quite opposed to that true and keen-edged organicism represented by Cuvier and later by Haldane, which denied the bare utility and legitimacy of the experimental analysis, and which was not unjustly satirised by Woolf in 1927:—

"You cannot demonstrate the soul
Except upon the animal as a whole
Spiritual autolytic changes begin
As soon as you push a needle through the skin."

Haldane's writings and those of his school, such as J. A. Thomson and C. G. Douglas, had, however, little effect on the direction taken by biological science in the first years of this century. As A. D. Ritchie pointed out, it is extraordinarily difficult to find out anything about living systems, unless their parts are treated in isolation, even if that be recognised as but the preliminary for imaginative synthesis, and as many observers said, Haldane's own researches in the physiology of breathing afforded an excellent example of the usual scientific method. Biological research proceeded steadily on the usual lines, for Haldane's practical counsels could only be followed by those who were willing to abandon causal explanations in biology or to give up the hope of biology becoming an exact science.

An influence was at hand, however, which was to lessen very much, if not to destroy altogether, the attraction of Haldane's opinions for biologists. A. N. Whitehead boldly extended the concept of the organism to cover all objects, i. e. all events, non-living as well as living. The word "inorganic" would thus cease to apply to non-living nature and all physical systems would be regarded as in a sense incomprehensible, except when regarded as wholes composed of parts owing their very existence to their share and arrangement in the whole in question. Quoting Tennyson's, " 'The stars,' she whispers, 'blindly run'," he remarked that an electron within a living body is different from an electron outside it only by reason of the plan of the body. The electron blindly runs within or without the

body, but it runs within the body in accordance with the general plan of the body and this plan includes the mental state. "But this principle of modification is perfectly general throughout nature, and represents no property peculiar to living bodies." Lloyd Morgan recognised in these Whiteheadian organisms his "systems of relations going together in substantial unity," which he had conceived of as stretching in degrees of ever vaster complexity from the smallest physical event to the universe itself. It was Lloyd Morgan, indeed, who first pointed out the significance of Whitehead's arguments for biological thought. He showed that the extension of organicism to cover the entire world of physics had no serious consequences for biological mechanists, who would continue to employ physico-chemical methods as before; provided that they had not adopted some form of scientific naturalism. At the same time, it could have little help for those who had insisted that the principal characteristic of living things was their organismic character, and had been led by this to propose far-reaching alterations in scientific logic or to give up the hope of causal explanation in biology. If, as it would seem, there are organisms everywhere, then the position that there are organisms nowhere turns out to be better placed than the position that living things are organisms and not other things, for, in the former case, peace can be at once secured through the Kantian method, while in the latter case the irreducible characteristic of life is not organicism, whatever else it may be. As has been pointed out, Haldane's prophetic observations concerning the eventual meeting-place of physics and biology have perhaps at last been justified, but, if so, with but a barren benefit to neo-vitalism.

7. *Emergence*

We may now pass, by another small transition, from Organicism to theories of Emergence. Neo-vitalism in this form practically ceases to have any claim to the name, and approaches extremely closely to neo-mechanism. The principle of emergence in its simplest form is presumably the statement that there are levels of existence in the universe, at each of which some more complicated form of being comes into existence, containing some essence absolutely new, and which could not have been predicted, even if all the properties of the constituents of the lower order had been known. This is evidently a conception very close to that of the organism, for just as the living or non-living system, looked at from one point of view, ceases to be itself as soon as it is dismembered, so the new level of complexity, looked at from one point of view, consists of lower levels of complexity joined together in a way that could not have been foreseen, because its properties and peculiarities are not the sum of the properties and peculiarities of its constituents. But it is important to note that there are here two parentheses, namely, "looked at from one point of view," implying that there is another point of view, and though the discussion is complicated by the doubt as to whether Whitehead intends his organisms to be taken as a metaphysical theory, or as a scientific theory, yet in Lloyd Morgan the statement is clear that the emergent point of view has always a complementary one, the resultant point of view, "the emergent web and the resultant woof," as he calls it. This is really a new and more accurate way of putting the ancient antithesis of mechanism and teleology, for the scientific method involves the concept of resultance, since it continually seeks for the predetermining causes which must be in some way uniform

with their effects, while the advent of something absolutely new at each level, i.e., atom to molecule, colloidal aggregate to living cell, etc., is a speculation hardly germane to science and resembling the final cause.

We find ourselves back again, then, at the distinction between metaphysics and science, which was first seriously studied by Kant. Most of the confusion has arisen in the past through an insufficiently clear decision as to the nature of biology. Biology cannot be philosophical and scientific, emergent and resultant, indeterminate and determinate, teleological and mechanical at one and the same time.

8. *Neo-mechanism as the Apologetic of Physico-chemical Embryology*

Enough has now been said of the principal philosophical obstacles to exact, quantitative, or physico-chemical embryology, and nothing now remains but to outline its own theoretical basis. Anyone who was dissatisfied twenty years ago with the various forms of neo-vitalism which have already been discussed would have had no alternative but to accept the simple, though rather incredible, scientific naturalism of the preceding century, unless, indeed, he was acquainted with German philosophy, and understood the momentous consequences which flow from the apparently technical question, "How are *a priori* synthetic judgments possible?" The varieties of neo-vitalism may perhaps be thought of, in so far as they were not modern forms of difficulties which have for many centuries perplexed philosophers, as a series of reactions against mechanistic biology insufficiently distinguished from scientific naturalism. This confusion is well seen in the earlier phases of the American discussion which led up to the symposium of 1918. It is often impossible to tell, as in the papers of Nichols, Ritter,

More and Fraser-Harris, whether they are attacking the mechanical theory of the universe regarded as an ultimate metaphysical faith or the mechanical methodology of science.

Historically speaking, the starry heavens with their infinite spaces that terrified Pascal, and their mechanical order revealed by Kepler and Copernicus on the one hand, and the moral law with its teleological and theological implications, on the other hand, were never really faced at one and the same moment and taken seriously together until the time of Kant, who first subjectivated what had before struggled in the external world, and demonstrated that the contradictions of our thought sprang from the constitution of our own intelligence. "It has always been assumed," he said, "that all our knowledge must conform to objects. The time has now come to ask, whether better progress may not be made by supposing that objects must conform to our knowledge." *Omnis enim longe nostris ab sensibus infra primorum natura jacet.* . . . Lucretius had said, but Kant went further, and suggested that our intelligence can help us no more than our senses in the attempt to see things as they really are.

That many other currents of thought flow through the three great Critiques is a matter of comparatively small moment; this was the great service that Kant performed for philosophy, and in the light of it the scientific mind was relieved of the burden of having to believe finally in its own account of the world. But in the scientific controversies of the last century, Kant was forgotten, and the continual successes of the scientific method led to a naturalistic outlook, which was wholly unsatisfactory. It was supported by T. H. Huxley, Herbert Spencer, W. K. Clifford, Tyndall, Ray Lankester, and many others: it apparently still is by Chalmers Mitchell. But, as a widely

accepted attitude, it did not live long into the present century, and from such blows as Ward's *Naturalism and Agnosticism* and Aliotta's *The Idealistic Reaction against Science,* it never recovered. Physico-chemical biologists were thus left, as it were, without visible means of support, and existed for some time on a purely pragmatic basis, devoid of any epistemological comfort. Gradually, however, an attitude came into being which has been termed "Neo-mechanism." Karl Pearson provided an intimation of it when he said, "Those who say that mechanism cannot explain life are perfectly correct, but then mechanism does not explain anything. Those, on the other hand, who say that mechanism cannot describe life are going far beyond what is justifiable in the present state of our knowledge." A clear enunciation of it, informed with the charm of all his writings, was given by d'Arcy Thompson in the Aristotelian Society Symposium of 1918: "In the concepts of matter and energy," he said, "the Whole is not enshrined, mechanism is but one aspect of the world. These are the proper categories of objective science, but they are no more: the physicist is, ipso facto, a mechanist, but he is not by implication a materialist; nor is the biologist of necessity a materialist, even though he may study nothing but mechanism in the material fabric and the bodily activities of the organism."

But the two most definite recent statements of neo-mechanism are perhaps R. S. Lillie's memoir entitled "The Nature of the Vitalistic Dilemma," in the *Journal of Philosophy,* and a paper by the present writer in the *Hibbert Journal,* which were published almost simultaneously at the beginning of 1927. Lillie began by some ordinary observations on the past successes of physico-chemical causal explanations in biology. He then discussed the finalism of Rignano and applied to it an idea which he had previously

worked out with great ingenuity, namely, that all actions of living things which exhibit purposiveness or prospective significance may really be considered as factors tending to maintain the general world-equilibrium of species, both of that to which the individual animal belongs, and of all the others indirectly also. In this way there might be a mechanical aspect, as it were, of teleology, and purposiveness might be translated out of its native metaphysical language into scientific terms. It is doubtful, however, whether teleology retains any of its intimate characteristics when it is twisted into the terminology of dynamic equilibrium between species. It is much better to confine it to philosophy, as is presumably Kant's conclusion, when he speaks of the methodology of the teleological judgment, and excludes it from theology as well as natural science. But Lillie concluded that mechanical regularity and determinism—the necessary conditions for the action of any machine—are implied in any predetermined course of action leading to a definite end. The attainment of any such goal at all requires a mechanism, a regular succession of like actions and an invariance in the conditions of action. To say this is to accept the Aristotelian idea of two complementary bases of natural phenomena, teleology and mechanism, existing side by side, inextricably intertwined in the external world. The recognition of this is the first step towards the Kantian subjectivation. "Every biologist is aware," says Lillie, "in his non-professional moments that the possibilities of life are larger than the mechanistic view implies. This is only another way of acknowledging that the whole mechanistic conception is an incomplete, derivative, or abstract one. To regard it as philosophically final is a grave mistake." Thus Lillie remains convinced of the adequacy of physico-chemical biology, but expressly repudiates the elevation of mechanism into a metaphysic.

Lillie goes on to discuss the abstract, distorted and incomplete character of the world which is presented to us by the employment of the scientific method. "To say," he proceeds, "that life is 'nothing but' a combination of chemical reactions in a colloidal substratum is unscientific. Life may be and apparently *is* that in part but to regard any such scientific formulation as a complete and adequate representation of its total reality is simply to misconceive the structure of science." This is well said; life is indeed a "dynamic equilibrium in a polyphasic system," but also "Life is a manifestation of emergent creativity," "Life is a pure flame and we live by an invisible sun within us," "Life is a sad composition, we live with death, and die not in a moment," and, if you will,

> "Life, like a dome of many-coloured glass,
> Stains the white radiance of eternity
> Until death tramples it to fragments."

"The dilemma of vitalism is irresolvable," says Lillie, "so long as we regard the units, concepts, and formulae found valid in physical science not as abstractions but as primary and self-existent realities, by a combination of which all the properties of living beings as of other natural phenomena can be derived." The former view incorporates within itself that grain of truth which vitalistic views have always had; the latter has no place for it and embodies an ultimate philosophy teeming with metaphysical impossibilities, the greatest of which is probably that ancient materialistic **ὕστερον πρότερον**, the denial of the logical priority of mind.

My own treatment of the subject differed from Lillie's in its line of argument, but arrived at exactly the same conclusion. I contrasted what might be called the Democritus-Holbach-Huxley attitude in biology with the Driesch-Haldane-Russell-Rignano attitude, and concluded after ex-

amining them that both involved insuperable difficulties. The former led to the sterile plains of metaphysical naturalism, the latter presupposed impractical alterations in scientific methodology. Lotze was the philosopher to whom I went for help in the elaboration of a better standpoint. "The true source of the life of science," said he, "is to be found, not indeed in admitting now a fragment of one view and now a fragment of the other, but in showing how absolutely universal is the extent and at the same time how completely subordinate is the significance of the mission which mechanism has to fulfil in the structure of the world." And in another place, "We granted validity to the mechanical view in so far as concerns the examination of the relations between finite and finite and the origin and accomplishment of any reciprocal action whatever; we as decidedly denied its authority when it claimed acceptance, not as a formal instrument of investigation, but as a final theory of things." "Nowhere is mechanism," says Lotze, "the essence of the matter, but nowhere does being assume another form of finite existence except through it."

I went on to argue that, although Lotze made every effort to demonstrate how mechanism and teleology could fit together in the universe, he failed to do so convincingly, and that it was more satisfactory to follow the Kantian method, and make them necessary results of the priority of our ways of thought. "We may regard," I said, "the mechanistic view of the world as a legitimate methodological distortion, capable of application to any phenomenon whatever, and possessing no value at all as a metaphysical doctrine." Mechanism is, in fact, whichever of its forms defined by Broad, Cohen, Krikorian, and others, turns out to be the minimum requirement of science, not metaphysical materialism. It is necessary to maintain it on

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methodological grounds, but it is pernicious to allot it any wider value. It stands, in fact, as one of the kinds of way in which the human spirit reacts to the universe in which it finds itself, and it springs, as R. G. Collingwood puts it, directly from the ultimate root of all science, the assertion of the abstract concept. "He who generalises is an idiot," said William Blake, but that was an aphorism characteristic of the poetic or the religious mind. The scientific spirit is as profound as these, but it sets out upon a different path from the very beginning and reaches in the end a country different in every way. It directs its interest from the first to resemblances and differences between phenomena rather than to individual phenomena themselves, and the impulse to classify leads inevitably to the supremacy of mechanical causation. It stands "at diameter and sword's point" with observations such as "Everything is itself and not something else" and "Nothing is ever merely anything."

R. G. Collingwood has expressed this in a very memorable passage: "Mathematics, mechanics, and materialism are the three marks of all science, a triad of which none can be separted from the others, since in fact they all follow from the original act by which the scientific consciousness comes into being, namely, the assertion of the abstract concept. They are all, it may be said, products of the classificatory frame of mind, corollaries from the fact that in this frame of mind the universal and the particular are arbitrarily separated and the universal asserted in its barren and rigid self-identity. It is this barrenness and this rigidity which confer their character upon the doctrines of scientific materialism. Hence it is idle to imagine that materialism is justified in some sciences and not in others. It is idle to protest that science ought to surrender its materialistic prejudices when it finds itself face to face

with a non-material object such as the soul. No object is material, in the metaphysical sense of the word, except in so far as scientific thinking conceives it so; for materiality means abstractness, subjection to the formulae of mechanical determination and mathematical calculation, and these formulae are never imposed upon any object whatever except by an arbitrary act which falsifies the object's nature. This only appears paradoxical when we fail to see the gulf which separates the common-sense materiality of a table, its sensible qualities, from its metaphysical materiality, the abstract conceptual substrate of those qualities. It is this substrate whose transcendent or abstract existence is asserted by materialism. Hence we cannot distinguish objects like tables which are really 'material' from objects in whose presence science must unlearn its materialistic habits of thought. Materialism is no more the truth in physics than in psychology, and no less. It is the truth about any object, just in so far as this object is by abstraction reducible to terms of pure mathematics; and no object is so reducible except by consciously or unconsciously shutting our eyes to everything which differentiates it from anything else. This conscious or unconscious act of abstraction is the very being of the scientific consciousness; and it is therefore no matter for pained surprise when science shows a bias towards determinism, behaviourism, and materialism generally."

By this time the general outlines of this theoretical excursus should have become clear. Embryology, to put it plainly, has been for so many years the happy hunting ground of vitalistic and neo-vitalistic theory that those who hope to see it become an exact science can hardly do without some kind of defence for their labours. "Vitalistic conceptions," said Claude Bernard in 1875, with the voice

of authentic prophecy, "can no longer hover over physiology as a whole. The developmental force of the egg and the embryonic cells is the last rampart of vitalism, but in taking refuge there, it transforms itself into a metaphysical concept and snaps the last link connecting it with the physical world, and the science of physiology."

It is to be hoped that what has been said will place in a right light the aims of the newer or physico-chemical embryology, and provide it, as it were, with its decretals. That they are not false will be the hope of every exact biologist.

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THE NATURE OF CHANGE

I

IT has been customary for certain recent idealists who hold that change is unreal to assume that the decisive question to be asked in an enquiry into change is the blunt and obvious question, *what changes?*[1] Change, it is said, clearly implies something that changes. What, we should ask, first and foremost, is this something that changes? The result of this quest, however, it has always been shown, is anomalous. The idealist has clearly established not only that he cannot say but that no one can truthfully say what it is that changes. This conclusion has sometimes been challenged but I think it is true. Nothing changes and the question, *what changes?*, can be given no positive defensible answer. The idealist at this point, however, has always taken a farther step. He has held not only that nothing changes but that because nothing changes, change is a mere appearance and not a reality. Realities, it is commonly admitted, appear to change, but in truth, as the argument shows, no reality can change. So change, the idealist argues, is a seeming, an external show: it is a deceptive appearance which realities sometimes have for us but only this and it is not itself a reality. I think this conclusion is indefensible and invalid, and the chief negative aim of this essay is to show that it is false. This I shall

[1] *E. g.* McTaggart, *The Nature of Existence*, vol. 2, pp. 12 ff., and Bradley, *Appearance and Reality*, eighth impression, pp. 45 ff.

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develop in section two below. The chief positive aim of this essay, to be developed in sections two and three below, is to show that change is indeed substance and that the nature of change, far from being the nature of a deceptive appearance, is the nature of a genuine and a *bona fide* form of reality.

Before I develop either of these theses however, one point should be made certain. This is that the idealist's claim that nothing changes or that change is the property of no reality, is true. We have said that it is true but such a position, as we observed, has sometimes been challenged. Our assertion thus should be given proof. I will therefore first of all endeavor to establish briefly and without undue repetition of familiar arguments that nothing changes or that change is the property of no reality. Then I will consider and seek to determine what necessarily follows and what does not necessarily follow as to the nature of change from the fact that this is true.

II

Let us therefore first ask, *what changes?* The realities commonly believed to change are things and thoughts, events and facts, qualities and relations. Or at least some of these are some of them. Let us call any reality said to change A. Then A is a thing or a thought, a fact or an event, a quality or a relation, or a reality similar to these. It is clear that the realities represented by A, if they change, must change as whole or else they must change at some point where they are not yet whole. Accordingly we may ask:—when A is said to change, is it meant that A as a whole, *i.e.* A as all it ever really is, changes? Or is it meant that A as it is before it is all it ever really is, changes? One is meant. Which?

The first alternative is plainly impossible. A as

whole or A as all it ever really is, cannot change. For a reality can change, if at all, only into what it can really be. But A as a whole is already all A can ever really be. There is thus no change possible to A here. Accordingly when a person asserts that A changes, he must mean that A as it is before it is all it ever really is, changes. But this position has two defects. In the first place, strictly speaking, the reality said to change is certainly not A but P—where P is A as it is before it is all it ever really is. And in the second place, when P is said to change, we may legitimately ask, is it meant that P as whole changes or that P as it is before it is all it ever really is, *i.e.*, p changes? Clearly one of these must be meant when P is said to change. Yet in neither case does P change. For if it is said that it is P as it is before it is all it ever really is, that changes, then, strictly speaking, it is p and not P that here changes—if anything does change. But if it is said that P as whole changes, how, we may ask, can this be? For P as whole is all P ever can really be. And since a reality can change, if at all, only into what it can really be, there is here no real change possible to P.

I take it that this argument is conclusive. For clearly we start an infinite regress if we go farther—*i.e.*, if we affirm that after all it is p that changes. For once again we may ask: it is p as whole or p as it is before it is all it ever really is, that changes? And once we ask this question it is clear that p itself cannot change and that in the search for the changing we should be forced to split up p as we have already been forced to split up P and A. And this would have no end. The argument is therefore conclusive: a changing reality can never be reached. The principle of the argument is this: if in the search for a changing reality you consider the reality said to change

as less than the whole of what it really is, you have, strictly speaking, only a section of the reality and not the reality itself; but if on the other hand you consider the reality as the whole of what it really is, you have indeed the reality but you have not and cannot have change. This principle automatically re-applies in any attempt to escape it by finding change in a sub-division of the original reality. There is therefore no way of genuinely evading it.

The idealist so far is consequently correct. *A* cannot change and no sub-division of *A* can change. And therefore no thing or thought, no fact or event, no quality or relation, or any other reality, can truly be said to be a changing reality or to possess the property of changing.

III

It will be remembered that we wished to establish this point merely by way of introducing properly the consideration of a deduction commonly made from it by the idealist. The deduction is this, that change is not real. Realities, it runs, appear to change and in common speech we constantly assign to them the property of changing. But truly, as we have just seen, no reality can change. Therefore change is a mere appearance, a seeming commonly believed but not true. And apart from this it is a deception and not at all a reality.

I think that this deduction is invalid. It appears innocently to follow from the mere fact that nothing can change. But really, to have genuine necessity and validity, it requires not merely this fact. It requires also that the assumption underlying the initial question, *what changes?,* is one which we have to admit. This assumption is that change is a property or a quality of a something that changes. When we ask the question *what changes?,* that is, we assume that change is a property or a quality of a some-

thing changing. If this assumption were genuinely necessary, if change to be a reality had to be a property or a quality, then I think that the above argument which shows that change cannot really be a property or a quality, would also have established that change is not real. But must we assume as does the idealist who asks *what changes?*, that change is a property or a quality? I see no necessity for this. Uncritical thought, as well as the idealist, it is true, constantly assumes that change is a property or quality and is forever talking about changing thoughts and changing things, and so on. But critical thought I think may equally assume that change is something entirely different from a property or a quality. For instance, critical thought may assume that change is substance—*i.e.*, that which among other things possesses properties and qualities but is not itself a property or a quality.[2] This assumption is perfectly open to critical thought. Indeed cogent reasons may be given why critical thought not only can make this assumption but can also hold that unlike the assumption of the idealist and of common thought it actually fits the case of change. If this is true and I shall argue in a moment that it is true, then the fact that nothing can change certainly does not prove that change is not real. It merely proves that change can not be, as commonly assumed and as assumed in the question *what changes?*, a property or a quality of anything real. I think it does prove this and that change is not a property or a quality of anything real. But so long as we may assume and assume with reason that change may be some other form of reality than a property or a quality, I think that the above dialectical victory of the idealist certainly

[2] The exact definition of substance is: substance is that which possesses characteristics but is not itself a characteristic. By a characteristic is meant a quality (a property) or a relation. This definition is the definition of substance ably expounded by McTaggart in *The Nature of Existence*, vol. 1, chap. 6.

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does not prove anything more than that change is not the kind of reality that it is commonly assumed to be.

Critical thought as against common thought, we say, may assume that change is substance, not property or quality. Indeed I think it should assume that change is substance. And this is the central thesis of this essay. This thesis is based on the fact that the assumption is not only abstractly possible (as is any assumption) but is actually necessitated by a combination of three circumstances, which are these:

(1) Change appears to be a fact. Indeed Mr. Bradley who argues against the reality of change, says that change certainly is a fact.[3] This is arresting. We may indeed insist with Mr. Bradley that metaphysics cannot accept facts uncritically. But if we are confronted with a fact that certainly is a fact, we should certainly try out every plausible explanation of this fact before we condemn it as a mere appearance. Otherwise we surely cannot be said to have dealt with this fact critically.

(2) The assumption that change is substance however is not only one whose trial a critical understanding should in this case demand, but it appears anyway to be forced upon us by the outcome of the argument that change cannot be a quality. Two properties of every substance, as we have said, are that it possesses qualities and that it is not itself a quality. Change possesses qualities as we shall see, and it is not itself a quality as the above argument has established. Thus change appears to have the properties that a substance always has. An objection may be made to this. The above argument, it may be said, proves only that change cannot be a quality, but this no more forces us to assume that change is substance than it forces us to assume that change is relation.

[3] *Cf. Appearance and Reality*, p. 206.

Indeed it may be contended that change is relation—*e.g.*, the relation between substances and their qualities. This contention I think is wrong. In the first place, change certainly cannot be the relation between substances and qualities. For a quality as a quality is possessed by a substance and a substance as such possesses its qualities, so that each stands to the other in the relation of possession. But the mere connexion of possession is not the fact of change. A shoe may possess blackness and blackness may be possessed by a shoe, but the connexion existent between the shoe and the blackness is certainly not the fact of change. In the second place, change cannot anyway be a relation at all. For a relation is always a connexion between terms, whereas a change is always an event—it is, for instance, the occurrence of a new connexion between the terms or the occurrence of a new set of terms. A change, that is, is a happening of the new, whereas a mere connexion between terms or a relation is never the happening of a new connexion nor the happening of anything old or new. Thus change cannot be a relation. Moreover it now appears doubly certain that change is substance. For first of all change is, as we have said, an event, and an event is a substance since it possesses characteristics and is not itself a characteristic.[4] And in the second place a substance (to repeat) is that which possesses qualities and relations and yet is not either a quality or a relation. As we shall see change possesses qualities and relations and as the idealistic argument and the above argument show, change is not a quality and change is not a relation. Thus change actually does fit the form of reality that is called substance.

[4] See, for instance, McTaggart, *The Meaning of Causality, Mind, N. S.*, vol. xxiv (1915), p. 326 ff.

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(3) Finally, the assumption that change is substance can yield a coherent and a positive account of the nature of change. This account I shall try briefly to outline in the section below. In the meantime it may be noted that an account of change such as Mr. Bradley's not only is uncritical in that it ignores all but one plausible explanation of the certified fact of change. But it is also in the end inadequate and unhelpful in that it yields only a negative account of change. For really the Bradleyian account tells us only what change is not, that change is not a property or a quality of anything real, and it merely adds to this the warning that we may not insist that change is a property or a quality without degrading change to the rank of a mere appearance. Apart from this negative information, Mr. Bradley's account of change tells us nothing at all about change. When we ask of it, *what is the nature of change?*, it replies merely that change is something that appears to be a quality of realities but really it is not and it cannot be a quality of anything real.

The assumption that change is substance we say can yield a positive and a coherent account of the nature of change. In the following section I shall endeavor to state what this account of the nature of change is.

IV

Two difficulties stand in our way. In the first place, it has been said that substance is an empty and meaningless concept. And there is truth in this. Substance is indeed an empty and meaningless concept if by it is meant an unknowable substratum. That has been clear at least since Berkeley. But if substance is defined as that which possesses characteristics (qualities and relations) but is not itself a characteristic, then the concept of substance I think is full of meaning. There are two reasons for

this. In the first place, substance, as here defined, is an existent, if anything at all is an existent. This has been shown by McTaggart[5] with great lucidity and skill and I can do no better than refer the reader to his proof of this. In the second place, substance, as here defined, being an existent, our definition of it is true, so substance has besides mere existence the characteristics assigned to it in its definition if anything ever has. Accordingly the concept of substance as used here not only refers to an existent if any concept does, but, since this existent has the distinctive characteristics other than mere existence assigned to it in its definition if any existent has, this concept contains a valid description of the nature of this existent beyond its mere existence. For these two reasons I submit that one could find no less empty and meaningless concept than the concept of substance as it is defined and used here.

The second difficulty may be stated in the form of a question. What anyway can you mean by change, we may be asked, if you do assume that change is substance? Aesthetically, I suppose, the most simple examples of change are instances of flow—the flow of a river, of the smoke of a cigarette, of the wind. Let us then take these examples as a clue to a comprehensive statement of the nature of change as substance. Each of these examples of change, it is observed, involves what might be called a "thing"—a river, a patch of tobacco smoke, the wind. And this I think is generally true. There is always some "thing" existent where there is change existent.[6] An empty change or a change that involves nothing, is, I think, a mere fiction. Let us then define the total content

[5] *Op. cit.*, vol. 1, bk. 2.

[6] Provided of course the reader will be gracious enough to permit us to assume that persons and animals as well as rivers and air *and the like* may be classified for the purpose of the argument as things.

and nature of a thing, as it is at any moment—for instance, the total qualities, relations, substance, whatnot, of the river, the cigarette smoke, the wind, as they are at *t*—as a *state*. Then, in an instance of change, the occurrence of any state of a thing, if not the thing's last state, is followed by the occurrence of another and somewhat different state (*i.e.*, the total content and nature of the thing at *t'*) and this, if not the last state, is itself followed by the occurrence of another and somewhat different state (*i.e.*, the total content and nature of the thing at *t''*) and so on. The occurrence of any one of these new states we will then define as a change and the occurrence of an unbroken series of new states we will accordingly define as a Change, and by change we will mean either a change or a Change or both.

Change so defined is substance. For it possesses characteristics (qualities and relations): *e.g.*, it has the quality of including a new state or a set of new states and it stands in the relation of inclusion to the new state or new states. And change here is not itself a characteristic or a quality or relation: nothing is here described as being or as having the quality of changing, nor is change described here as a relation of any sort. Indeed change here is described wholly as an event or as a series of events—as the occurrence of one or several qualitied and related states of a certain sort. Accordingly change here is substance. It is not a characteristic, yet it possesses characteristics. And this is what is meant by substance.

By way of establishing more firmly and of amplifying sufficiently this account of the nature of change I will first of all consider three important objections that may be made to it.

(1) We have defined change in terms of the occurrence of states of ***things***. But it may be objected, in the

first place, that an event as well as a thing has states and the occurrence of any new state of an event would therefore equally be a change. Thus, according to the position here, there would be instances of change that would not be instances of the occurrence of new states of things, and our definition of change, which limits change to the occurrence of new states of things, would therefore be inadequate and false. It might be further pointed out, as a second part of this first objection, that the occurrence of a new state of an event is itself an event, and since an event has new states, this event would have new states. And further, the occurrence of these new states would themselves be events and they would have new states, the occurrence of which would themselves be events, and so on *ad infinitum*. Thus our definition of the nature of change, according to this first objection, would not only be inadequate, in that it does not cover certain cases of change, but, if it should be expanded so as to cover these cases, it would commit us, at least in certain endeavors to denote change, to the torments of an infinite process. In reply to this objection we might proceed in several ways, but I think it is sufficient to observe that the assumption out of which the objection is constructed is invalid and false. The whole objection assumes that an event, like a thing, has or may be truly viewed as comprised of states. But this is certainly false. For a state is always a total which, like a state of a thing, is fixed and set. It is intrinsically devoid of the character of passage or of going-on. An event, on the other hand, is always a process, a transition, a going-on, and is never, *in toto* or in any of its actual experienced sub-divisions, fixed or set. In its minutest real parts it is a passage, a going-on. Thus the analysis made here of events into static slivers is essentially an analysis of events into what events never can be

and never are. It is false. And since this first objection is constructed entirely on the assumption that events may be analyzed into static slivers or viewed as comprised of states, it is also necessarily invalid and false.

(2) The above objection may however be rehabilitated. It may be pointed out that even if we do deny that events are comprised of states, we do admit that events have parts and may be validly viewed as comprised of parts. And thus it may be contended that the occurrence of a new part of an event is a change and therefore that change includes not merely the occurrence of new states of things as we say, but also the occurrence of new parts of events. I think there is truth and error in this objection. The objection is true in insisting that there is more than mere states of things involved in change. There are events. But in the main the objection is mistaken. For the objection supposes that a change can be the occurrence of a mere new event (a new part of an event is itself a new event), whereas a change, as I think, can never be the occurrence of a mere new or an empty event. An empty event is I think a creature of abstraction. It has a logical or conceptual, not an ontological or factual, reality. We can never experience, point to, or show decisively the existence of a mere or an empty event. Thus no real change could ever be the occurrence of a mere or empty event, as the present objection supposes. Indeed every real change, as I believe, may always be analyzed into (a) an event, and (b) a new state of some "thing." And it is in view of this that we have defined a change as the occurrence or the eventuation of a new state of a thing.

(3) A final objection may be made to our definition of change. It may be objected that our definition of change in terms of *states* of things is quite arbitrary and un-

needed. Why not define change in terms of the occurrence of a new quality or of the occurrence of a new state of an existing quality of a thing, we may be asked? Or why not define change in terms of the occurrence of a new relation of a thing or of the occurrence of a new state of an existing relation of a thing? Either of these definitions would be a definition of change as substance and should serve our purpose. The choosing of a definition of change in terms of the occurrence of new states of things therefore is quite arbitrary and superfluous. I doubt it. It is true that the occurrence of a new quality or the occurrence of a new state of an existing quality, is a true example of change as substance. But such examples would hardly enable us to map out and define change since the occurrence of a new relation or of a new state of an existing relation is equally a true example of change as substance but would be excluded from the list of changes if change were defined wholly in terms of the occurrence of new qualities or of new states of existing qualities, since a relation can not be reduced to a quality.[7] On the other hand, our definition of change in terms of the occurrence of new states of things includes both of the above species of change, since the occurrence of a new quality or of a new state of an existing quality, or the occurrence of a new relation or of a new state of an existing relation, would mean that the total qualities-relations-whatnot of the thing at the time of the occurrence was different from the total qualities-relations-whatnot of the thing immediately prior to the occurrence. That is, the occurrence of either of the above types of novelty (the qualitative or the relational) would mean the occurrence of a new state. Thus our definition of change in terms of the occurrence of new states is neither arbitrary nor

[7] The proof of our assertion that a relation cannot be reduced to a quality would be the same as that given by McTaggart, *op. cit.*, vol. 1, chap. 8.

unnecessary. It includes what is contained in the above two alternatives. It is required for comprehensiveness and it has been dictated by that requirement.

The above I think constitute the important objections to our account of the nature of change. Our general position, that change is substance, it is true, we have not called into question. But this position rests upon our proofs that change is not a quality and that change is not a relation and that change nevertheless possesses both qualities and relations. And this proof I think we have already sufficiently considered. With the above objections removed, I will, by way of rounding out and completing our account of the nature of change, consider two minor problems to which it gives rise.

(1) We should be clear as to (a) the relation between the events involved in Change, and as to (b) the relation between the states involved in Change. In both cases, I think, the relation is a kind, though a different kind, of continuity. In the first place, (a) there is continuity between the events involved in a Change. That is, the events in a Change occur without break, so that between the occurrence of any two immediately successive events in a Change there is in that Change, provided these events are immediately successive, no intervenient event. That is, there is there no occurrence of a third event. This definition of continuity is of course different from the orthodox or mathematical definition, according to which continuity is that property of a series in virtue of which there is always in that series a third term between any two. This difference I think is no objection to our own view. For the events of which we speak in our account of change are conceived to reside in nature as presented in actual experience, whereas the mathematical concept of continuity is never actually illustrated by nature as it is

presented in actual experience. Nature, so presented, you are never able to divide up into spatial and temporal parts which, within any experience, always have a third part actually between them. It is indeed only when you reduce presented nature to such entities as points without magnitude or parts and moments without duration or extent—*i.e.*, it is only when you reduce presented nature to infinite sets of abstractions, that you have terms to which the mathematical concept of continuity accurately applies. Thus our deviation from the orthodox concept of continuity is natural, not objectionable. Moreover I am inclined to think it is very advantageous. For the mathematical definition of continuity applied directly to the object-matter of actual experience, is beset with many difficulties.[8] But these are so far forth irrelevant to the view of continuity stated here. (b) The states involved in change as well as the events so involved exhibit continuity. Each of these states, we have said, is the total content of a thing as it is at any given time. The continuity between the states involved in a Change refers to the fact that the content comprising a given state of a thing (S) contains something of the content comprising the immediately prior state of the thing (S′). Between these contents, that is to say, there is no complete break but a continuation. And this would be true even where one state in a Change appears quite different from its preceding state, as the state of a bomb at explosion appears quite different from the state of the bomb as it was when about to explode. Moreover, as a rule, two states in a Change that occur nearer each other in time, tend to show

[8] For a few of these the reader may refer to the present author's article on causality in *Monist*, April, 1930, wherein certain deductions from the mathematical theory of continuity made by Russell and Bradley are mentioned and there is indicated the morass we encounter if we hold that the mathematical theory is valid for the object-matter of actual experience.

greater continuity of content than two that occur less near: the closer the occurrence of any two states in a Change, the greater, as a rule, is their contentual continuity.[9] Such then is the relation between the states involved in a Change. It is a relation of continuity. This continuity differs somewhat from the continuity between the events involved in a Change. The latter refers to the fact that there is no break in the occurrence of the events in a Change, the former refers to the fact that there is no break in the contents comprising the states involved in a Change.

(2) Finally, we have spoken of events and states. change and Change, and we should be a bit more clear as to the relation of these. A change as we have said is the occurrence of a new state. That is, a change involves (a) an event, and (b) a new state. A Change, we have said, is the occurrence of a continuous series of new states. That is, a Change involves (a) a continuous series of events, and (b) a continuum of new states. This I think suggests the true relations between events and states, change and Change. A state or an event stands to a change, and a series of states or a series of events stands to a Change, in the relation of inclusion or ingrediency. As to the relation between the states and the events in change, it may be sufficient to indicate that one (the events) constitute the mere occurrence of change, the other (the states) constitute the contents, the what, above the mere occurrence, which has occurred. That is to say, the relation between an event and a state in a change, and between a series of events and a series of states in a Change, is the relation between a *that* and a *what* as this relation manifests itself in actual experience. How we should label this relation it may be difficult to

[9] *Cf.* C. D. Broad, *Perception, Physics, and Reality*, p. 103.

say, but that the relation exists, is clear enough. Any change, for instance, may be analyzed into an event or a set of events and a state or a set of states, but it is evident to the analyst that the state and the event, the states and the events, exist in actual fact as bound together in a whole. The two exist in an indissoluble relation. What we should call this relation I gladly leave to the decision of a creative philologist. It is enough for our purpose to indicate the relation and to convey some idea of what it is.

V

Such as I think is the true nature of change. Change is always events of a certain sort—namely, the occurrence of new states of things. And its form as a reality is what is technically defined as substance.

In this article we first endeavored to determine what type of reality if any change is. That it is a quality as commonly assumed or a relation as sometimes contended, we had to deny. But we found, in part in this very denial and in part in the knowledge that change possesses qualities and relations, that change fits exactly that type of reality called substance. We then endeavored to define the nature of change as substance and to defend and expand this definition. Much it is clear remains:—certain broader issues involved in change—its relation to the uniform and to reality as a whole, for example—have not been touched. And such matters are important, although I think that because they are more ultimate they are hardly relevant to a re-orientative discussion of the topic such as ours. The urgent need is indeed I think to recollect that change is a fact and to see the problem of change as the task of discovering whether this fact of change can fit a form

of reality. The idealistic quest as to *what changes?* must be held to be indecisive and be removed from a central position, although at the same time the truth in the idealistic argument should be acknowledged and not ignored as it is in so much current writing on change where change is constantly assumed to be a property or a quality and mention of "changing things" and "changing relations" and so on clutter the pages. Indeed the truth of the idealistic argument might well be taken as a hint or guide and the problem of change be re-approached and re-formulated with this truth in mind. Such in any case has been our clue in this essay, both in defining the true problem of the nature of change, and in the discussion of change as substance.

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BACK TO DIALECTIC

I

ABSOLUTE idealism forms one vast arch of function spanning the nineteenth century; springing from the earth when Fichte denied the reality of the thing-in-itself of Kant; reaching its highest point in Hegel; coming to earth again in the criticism of the new realists, and the critical realists.

Only the generic aspects of the movement are to be considered in this discussion. Questions whether Hegel confined his dialectic to existence or conceived it as extending to all possibility, whether his specific categories are properly related to each other, whether his line of development of dialectic is the only line, are aside from the point. Likewise all interpretations of idealism as an effort to reduce the not-self to terms of the self do not concern us here—that particular reductive tendency is only one aspect of the general problem. Absolute idealism in its most general aspect is a doctrine of the constitutive character of relations, the gist of its teaching being that relations are internal to their terms. That signifies ultimately that the thing-in-itself in its perfect self-sufficiency is denied in the interest of an organic whole of reality. This is the strategic point where the controversy must center.

To those who have been once under the spell of the genius of absolute idealism there is usually little doubt of

the truth of this interpretation. Fichte, though still in the thrall of the *I* and the *not-me,* was concerned to reduce the different fields of Kant's philosophy to the terms of one common principle. The thing-in-itself, the theoretical reason, the practical reason, were to take their warrant from the nature of reality as a whole; the categories, instead of being accepted arbitrarily, were to be deduced from the undeniable postulates of experience. Though Fichte remained subjective to the end and retained irrational elements, he had started the movement on its course.

Hegel's philosophy was the triumphant completion of the undertaking. His criticism of the Kantian position makes clear his doctrine as usually accepted. Kant's system was dualistic and as such subject to condemnation. A fundamental defect in Hegel's eyes of every dualistic system lay in the fact that at one moment it unifies what has been explained at a previous moment as independent and unassimilable. If the thing-in-itself is considered as a limit that conception of it does not avoid the difficulty, for one knows a limit or defect only when he is above and beyond it. To call a thing finite or limited or imperfect is to imply the infinite and unlimited. In thus wholeheartedly condemning Kant as dualistic he is unreservedly taking his stand on the side of the doctrine of an organic whole of reality. In criticizing Fichte for substituting an impulse for Kant's thing-in-itself he is only moving further in the direction of the organic whole.

One wonders if in his doctrine of dialectic involving the principle of negation and contradiction with its thesis, antithesis, and synthesis Hegel has not restored the element of finiteness which was lost when the thing-in-itself was abandoned. If the contradiction involved in the thesis and antithesis were real and not merely apparent, each might be a thing-in-itself persisting as an

abstract identity even after the synthesis. This was an essential implication of Hegel's system but it is doubtful if either Hegel or his followers ever realized its full significance. Theses and antitheses, according to his doctrine, collapse without a remainder into the conquering synthesis; evil is only a disappearing moment, an illusion which belongs to finite spirits as such; and dialectic is a one-way street to reality. Even if *aufheben* may be interpreted as meaning *to preserve* as well as *to supersede,* the spirit of Hegel does not stress the preservation of the superseded contradiction in its identity as unassimilated. The stress is everywhere on the emergent synthesis. In other words, the real is the rational.

That Hegel's followers have clung to this doctrine in its essential features is too well known to need extended comment. Though Bradley gives a better logical justification for pluralism than do the pluralists themselves and comes nearest of all the absolute idealists to subscribing to that doctrine, even he runs true to form in exalting the Absolute. "Plurality and relatedness are but features and aspects of a unity."[1] "The character of the real is to possess everything phenomenal in a harmonious form."[2] "The Absolute holds all possible content in an individual experience where no contradiction can exist."[3] Making still more explicit the idealistic position he says: "Being and reality are, in brief, one thing with sentience."[4]

Royce, not troubled with Bradley's logical difficulties, expresses himself with no hesitation. In his Fourth Conception of Being he says that God sees "the one plan fulfilled through all the manifold lives, the single consciousness winning its purpose by virtue of all the ideas,

[1] Bradley, *Appearance and Reality,* p. 142.
[2] *Ibid.,* p. 140.
[3] *Ibid.,* p. 147.
[4] *Ibid.,* p. 146.

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of all the individual selves, and of all the lives." "We have no other dwelling-place but the single unity of the divine consciousness." "We are eternally at home in God."[5] And the reasoning of the "Supplementary Essay," though more analytical, expresses the same idea. "Infinite variety is developed out of unity."[6] "Internal variety is subject to" and "merely expressive of" "the single plan whereby, at one stroke, the absolute is defined, or rather defines itself, as a self-representative system."[7] And again, he speaks of a "multiplicity of Individual facts that are still One in the Absolute."[8]

Principal Caird can find a solution of the problem of the relation of the mind to nature and of the finite mind to God "only by apprehending the Divine and the Human, the Infinite and the Finite, as the moments or members of an organic whole, in which both exist, at once in their distinction and in their unity."[9] The true Infinite is "the organic unity of the Infinite and Finite."[10] Again, the finite has no "independence or individuality which cannot be brought back to a higher unity."[11] And so we might continue through Bosanquet, and other outstanding followers of Hegel, but the general movement of all of them toward the Absolute needs no proof. In spite of logical detours all roads lead to that delectable mountain. What has been set forth here has been presented only to furnish a basis on which to develop the main thesis of this discussion.

Bradley displays, as before intimated, a variation of the idealistic argument which ought to lead to a supple-

[5] Royce, *World and the Individual*, First Series, pp. 426-427.
[6] *Ibid.*, p. 523.
[7] *Ibid.*, p. 545.
[8] *Ibid.*, p. 554.
[9] John Caird, *Introduction to the Philosophy of Religion*, p. 229.
[10] *Ibid.*, p. 231.
[11] *Ibid.*, p. 244.

mentation of his doctrine. He apprehends the necessary self-identity of terms, knows that they must nevertheless stand in relations and be assimilated into larger wholes, admits that he does not know how this can be done. Royce in criticism of him interprets all of his infinite regresses as self-representative series and insists that as such they are not self-contradictory. Bradley with his incisive study of relations must have seen that the terms in such series would, in order to occupy any place at all in the series, have to be identical with themselves and as such would present a logically unbridgeable gulf between themselves and the relations of the series.

As is well known, this position is made manifest time and again in his discussion of Appearance. It seems easy at first thought to make all relations internal to their terms and to conceive the universe as an infinite whole in which the parts mutually modify each other without limit. The less critical of the absolute idealists glory in this conclusion. Bradley, however, subjects this facile result to analysis. To take the most generic discussion, that on "Relation and Quality," "Qualities are nothing without relations."[12] A brief consideration makes this plain. if a quality is taken to stand out of relations the process of abstraction of which it is an end product persists and that carries with it a set of relations. Furthermore there can be no difference among qualities if there are no relations, for if the difference falls outside of any given quality, relation immediately asserts itself, and if on the other hand the difference falls inside of it we must distinguish within it itself and its otherness and we have then two qualities in relations. Thus we arrive at the conclusion of universal relatedness. That means that a quality is made by its relations. If it cannot be without

[12] Bradley, *Appearance and Reality*, p. 26.

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relations, they and it form one indissoluble unit. If relations are conceived to be responsible for a part of a quality, then that part is responsible for a part of the residue of the quality, and so on ad infinitum. In this way the road is cleared for complete absorption in the organic whole of the Absolute. But that is not all. Qualities with relations are as unintelligible as they are without them. "*A* is both made, and is not made, what it is by relations."[13] *A* must be identical with itself as different or there is no beginning of the accounting for the difference. Relations cannot precipitate terms that were not there before nor can they get on with no real differences beyond the mere ends of a line of connection.[14] By this analysis Bradley makes impossible an easy assimilation into the Absolute.

After the analysis of quality and relation it is easy, as Bradley admits, to apply the principles there involved to other fields of experience. Space is not a mere relation, for it must consist of extended parts and these parts are spaces. These spaces are identical with themselves—they are somethings. But spaces being indefinitely divisible dissolve into relations. The same analysis applies to time. "If you take time as a relation between units without duration, then the whole time has no duration, and is not time at all. But, if you give duration to the whole time, then at once the units themselves are found to possess it; and they thus cease to be units." But there must be units or there is no duration.[15] And regarding change, "Something, *A*, changes, and therefore it cannot be permanent. On the other hand, if *A* is not permanent, what is it that changes?"[16] In short, the starting-point

[13] *Ibid.*, p. 31.
[14] *Cf. ibid.*, p. 32.
[15] *Ibid.*, p. 39.
[16] *Ibid.*, p. 46.

must remain identical with itself or the change has no measure and no direction, but on the other hand if it remains thus identical it does not change. Causation shows the same difficulty. If the effect is different from the cause what is the connection between them, and if it is not different from the cause nothing occurs. *"Causation must be continuous." "Causation cannot be continuous."*[17] The gist of Bradley's dialectic is that identity and difference, though each is reducible to terms of the other, yet contradictorily must retain their essential characters.

[17] *Ibid.*, pp. 54-55, 60-61.

Indeed one may go farther than Bradley and show the same process of dialectic breaking out in the Absolute itself. The Absolute is, as he admits, nothing without its appearances. It is thus tied up in relation to that which taken as such is not the Absolute as such. As thus tied up in relation to something other than itself it is merely a quality in relation and suffers from the inherent dialectic of qualities and relations in general. If it be conceived as a mere limit of abstraction from which imperfection has been progressively removed, the process of abstraction itself survives and establishes relation between the rest of the world and the Absolute. And yet as a point of reference it survives identical with itself and inviolable. If it be maintained that the Absolute is so defined that it takes up imperfection as such into itself without a remainder, it must still be insisted that the imperfect as not yet taken up into the Absolute remains in some sense to specify the process of assimilation into it. The Absolute can have no character without the presence of its opposite. In fact the same arguments that were used against Spencer's Unknowable or non-relative, can be used against the infinite aloofness of the Bradleyan Absolute. The

Absolute is as necessary to the completeness of the universe as red or green or any other character and presents the same difficulties.

II

This leaves us at an impasse. The elements of the universe are unassimilable, even the ideal of assimilation being unassimilable, and yet they are all progressively assimilated. It is difficult to go with Bradley and admit that thought cannot make or accept differences, for apparently thought is only a high level of the very conflict which he has taken such pains to analyze. In fact if it is not that how can his analysis be valid? But it is also hard to go with Royce in his more optimistic theory of thought, for he seems not to appreciate the contradictory elements which Bradley has exhibited. The contention here presented is that the world is as full of contradictions as the latter believed and yet that, as the former believed, it can be thought. In one of the *Zusätze* of the smaller logic, Hegel states that "it is ridiculous to say that contradiction is unthinkable."[18] Taking the cue from him we may accept the worst of Bradley's analysis and yet not find the situation hopeless from the thought standpoint. The existence of contradictory determinations in the same thing is no harder to accept than the existence of a non-contradictory thing. Neither can be thought except in a situation in which both are present as factors.

The suggestion of this discussion is that, while the principle of internal relations, the consequent assimilability of terms, and the reality of the absolute is accepted, there be added a doctrine of identities to take care of the contradictory but no less vital identity of the terms

[18] *Smaller Logic*, Wallace's translation, p. 223, and his attitude is well known from numerous other passages.

that stand in relations. Such identities as we are advancing would come close to what Hegel would call abstract identities of understanding as distinguished from the type of concrete identity treated under the Doctrine of Essence. What we are trying to instate is the principle of identity as applied to anything whatsoever taken as such. It may involve the identity of a stage of causal process or that of a dream or any part of a dream or that of an error or an illusion or that of the wildest fancy or the identity of the absolute. Without such identities all change, from causal process to the flitting of attention, would lack specification and measure. They are different from the essences of Santayana in that they include the identities of existence—they are present in the flux. They may be subjective or objective, existent or subsistent, seen or unseen; they may span one moment or a thousand years.

Let us now examine what effect the addition of identities to absolute idealism has upon it. It insures that the emphasis which has always been placed on one limit of dialectic, namely the organic whole, is now placed on the process of dialectic itself. Synthesis loses its overwhelming importance as the "sublation" of contradictories and stands in equal partnership with thesis and antithesis. The synthesis has, it is true, all the assimilative power which has been attributed to it; as identical with itself in its own character it has overcome and wiped out the conflicting moments of which it is made; and the ultimate goal of synthesis, the absolute, has all the majesty that has been attached to it; but unless the lower categories maintain their identity as such the successive syntheses and the ultimate organism have no character as syntheses. Dialectic is no ghostly sublated wraith but the real battle of contradictories.

In keeping with this interpretation Nature is not

merely the absolute idea in the form of its otherness; it is at least that, but it is also *nature* identical with itself as nature, else the absolute idea would have no specification as the overcoming of nature. The abstractions, Being and Nothing, are not by definition so concrete as Becoming, but in the universe as a whole they are just as necessary as the more concrete categories. Action and Reaction in their alternation are more abstract than the pure self-reciprocation of the category of Necessity but in their character as such they are no less essential to the universe. Being and Essence (Hegelian) are as real as the notion. A great deal has been written about the necessity of the absolute for an intelligible world but the same thing can be claimed for every humblest existence or fancy. In fact, not only are we gifted by our doctrine with all the cogent reasoning of absolute idealism but we have an ontological pluralism beyond the wildest dream of the realist.

This is in fact a necessary condition for the working of the Hegelian system. As already intimated, dialectic had a definite place in the scheme: Hegel, though the absolute idealists failed apparently to realize its full significance, credits Kant with having presented the idea that contradiction is inevitable and essential. He then criticises Kant for teaching that thought or reason and not the world is the seat of contradiction. If attempt is made to save the reason from contradiction by confining contradiction to the categories of the understanding, he argues, reason becomes empty and indeterminate—it is saved from contradiction by the sacrifice of all its content. Neither the world nor reason can be saved from the inroads of contradiction. Furthermore, Kant did not make a complete study of the principle of antimony, according to Hegel, but limited it to four subjects taken

from the subject of cosmology. Antinomies in Hegel's view appear in all objects of every kind, in all conceptions, notions, and ideas.[19] Every actual thing involves a coexistence of opposed elements. Consequently to know, or, in other words, to comprehend an object is equivalent to being conscious of it as a concrete unity of opposed determinations. Contradiction is thus universal.

Then as to the *drive* in contradiction. The emphasis that Hegel put upon "negation" is well known. "Contradiction," he says, "is the very moving principle of the world." Bradley in all of his discussion of contradiction finds cause for worry—it interferes with the solution of the problem of knowing—but he finds no movement in it. For Hegel there was a movement. Too often metaphysicians have thought that if they pushed the problems of the world back to a complete personal ground that would account for activity. The *drive,* according to the doctrine here sponsored, is inherent in the broader field which includes the as yet ungrounded as well as the ground. The effect of this shift of emphasis is to exalt the dialectic process instead of the absolute.

But if contradiction is to play such an important rôle it must be real. It can be no conflict by courtesy, it can be no flunkey who says "By your leave" to the absolute. Each thesis and each antithesis must be identical with itself, needing nothing outside of itself, deep as the universe, in fact it must *be* the universe. And yet, in spite of the fact that the universe requires that it be thus abstractly self-sufficient, it can be real only in the process of something happening, only in the process of its becoming something else. The doctrine of identities here presented is the only doctrine that can give the "sublated"

[19] *Cf. ibid.,* sec. 48.

stages of dialectic sufficient reality to satisfy these conditions.

The usual thing in criticizing absolute idealism is first to realize that it does not do justice to the thing; then to realize the difficulty of knowing the thing, upon idealistic assumptions, if it does exist; and finally to adopt as much of idealism and as much of realism as seem to meet the several needs. Internal relations may be accepted in one place, as within the physical organism, while in another place, as in the knowing situation where internal relations would obviously modify the thing out of existence, external relations are adopted. This plan yields only a set of mechanical devices, and, at best, requires something outside of the machine to make it go.

If relations within the organism are assumed to be internal, it becomes immediately apparent that the terms related, though they be as intimately connected with the rest of the body as are ganglia and ductless glands, are something in their own character or the body loses all distinction within itself and collapses. The supposed internal relations must, then, at the same time be external or they cease even to be internal. Take, on the other hand, the assumed external relations in which a thing coming into the knowing situation is supposed to stand. Are we then to ignore all the differences in perception that come from differences in the perceiving organs, differences in apperceptive mass, in psychological set, in mood, in temperament? The strain upon credulity which this requires is too great. Then what is left? To take relations, on the one hand, as universally internal, absorbing all things ultimately into the absolute. The thing, error, evil, all things earthly, are then illusion. The only real from that viewpoint is the unalloyed joy of pure functioning or pure form freed from all taint of matter. This

must be accepted with passionate conviction. On the other hand we must take relations as universally external. All finite things, the flesh and the devil, as well as God and his angels, are real in themselves: they are not created by relations; they form an infinite discontinuum of identities. Both sides are real, the absolute of the absolute idealist and the identities of the realist. And the *drive* of the world is transferred from God to an immanent dialectic.

The phenomena of the empiricist, the thing-in-itself of Kant, the *Anstoss* of Fichte, the entities of the realist, and the Absolute of the Hegelian idealist have all the reality that has ever been claimed for them by their exponents. The searcher after truth will take no cross-section of nineteenth century thought but will embrace the whole movement from Kant to the recent realists with all their irreconcilable antagonisms. Nor will this mean that order will be banished from the world, for the polarity involved in these oppositions is orderly.

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INFINITY AND INDEFINITENESS

I

INFINITY was a much glorified concept until Hegel directed his pen against it. Prior to Hegel the meaning of infinity was inseparable from the meaning of eternity, as the sun's rays are inseparable from the sun. Infinity was the halo of eternity.

But at last this notion of infinity was disparaged. For Hegel labeled mathematical infinity "bad." It is true that he opposed to this "bad," or quantitative infinity, a "good" or qualitative infinity of the absolute. But the latter is practically equivalent to eternity. It is infinite in the sense of transcending and yet being presupposed by any finite entity. But it is a totality in itself and thus definite. It is well symbolized by the infinity of a circle which is a closed totality in opposition to the unending straight line which simply has lost its end. Linear infinity is then an image of the "bad" numerical infinity.

The lamentable rôle assigned to infinity on the stage of Hegel's philosophy was, no doubt, due to the contemporary definition of infinity, which was negative. An infinite number was defined before Cantor as a number which exceeds any assignable number. This definition implies an endless series of numbers. For no matter how great a number is assigned, one can always progress further by adding one. Hence the situation is essentially

indefinite. It indicates a possibility of advance. It does not indicate a numerical series as a totality, but is, as it were, a series in the making accompanied by a conviction that it will never be made.

It is "bad" because to venture on the path of numerical infinity would mean to enact a kind of mathematical Wandering Jew. The indefiniteness of that endless wandering makes it a philosophically unreliable and worthless concept. For it is an entity with shifting boundaries. Its vagrant nature is, accordingly, a source of ambiguities and paradoxes. Hence to handle it in a logical way successfully would be impossible.

Thus infinite number was condemned and scorned. But unexpectedly an appeal to mathematics reversed the judgment. It was Cantor who advanced a new mathematical definition of infinity which is positive and, furthermore, appears to correspond to what Hegel would have qualified as the demands of the "good" infinity. The new definition states that an infinite number may be defined as *the number of any aggregate that includes a proper part numerically equal to itself.*

In the first place, this definition may pretend to philosophical significance because it is expressed entirely in positive terms. Secondly, it appears to have exactly that miraculous trait which characterizes Hegel's absolute: i.e., an implicit presence of the whole in its parts.

This being the case it is no wonder that logicians and philosophers have welcomed the new definition. I understand that in the field of mathematics its application has proved fruitful and justified. But the enthusiasm of philosophers and the success in mathematics does not dissipate my doubts concerning the significance of the new definition.

Of these doubts the principal is that the new definition

is only seemingly positive, but in fact conceals within itself the old indefinite endlessness. That is to say, the new definition is intelligible only on the assumption of endless series.

In order to substantiate this doubt I shall try to show, in the first place, that the one-one correspondence which establishes equality between an infinite whole and its proper part would not be possible unless the series compared could be indefinitely increased. Secondly, the possibility of an indefinite advance is the only actuality so far as infinity is concerned. There is no actual infinite totality. The latter is an illusion arising from the illegitimate confusion between "any" actually assignable number of an indefinite series and "all" its members. This "all" is an imaginary entity.

The answer to this objection to the effect that "all" can be assigned *intensionally,* though it eludes any possible enumeration, leads to a short discussion concerning the relation between intension and extension, the outcome of which indicates that the new definition of infinity obliterates the distinction between intension and extension and, consequently, is unjustified in the appeal to such a distinction. For it turns out that the mathematical definition of infinity depends on the extension of the latter.

This point is of considerable importance and not only because of the blow to mathematical infinity. It has a positive significance; it suggests that the meaning of infinity lies in all cases in which intension entails extension. Such cases are found in the relationship between the levels of universals and particulars. More specifically, it is the relation of *recurrence* because this relation, in order to be intelligible, demands not only a universal character, but instances of its embodiment as well.

In view of this situation I advance a conjecture that

infinity denotes a recurrence, i.e., infinity translates a universal in terms of particularity. Since, however, the levels of universals and particulars are forever distinct, an adequate translation is impossible. According to an Italian saying all the translators are traitors. And the treachery of translation is betrayed by the essential indefiniteness of infinity.

These points are expounded more fully in what follows.

II

There are, of course, many different illustrations of the new definition of infinity. But for my purpose it will suffice to consider one. I take the most familiar case of all, the integers set in one-one correspondence with all the even number thus:

Case I A. 1, 2, 3, 4, 5. . . . .n,.....
B. 2, 4, 6, 8, 10. . . .2n,.....

The series B is only a part of the series A, since it leaves out of account all the odd numbers. Yet this part is equal to the whole because the two rows are set in one-one correspondence. Now it is assumed that one-one correspondence is the criterion of equality. Accordingly, inequality would mean either one-many or many-one relation between the members of two collections. Hence it follows that the one-one correspondence in order to establish equality must *exclude* the one-many and many-one relations.

This condition is important in our case of two infinite series, for it raises a doubt as to whether they can be arranged in one-one correspondence. Let us consider the logical implications of the condition of equivalence. The question is this: How is it possible to secure the exclusive one-one correspondence between the members of two collections?

The answer gives two possible alternatives. There may be a natural correspondence so that any member of the first series would not tolerate the company of any but one particular member of the second series.

This is a case of what Mr. W. E. Johnson calls *factual correspondence*. The one-one correspondence which holds between husbands and wives in a monogamic society may serve as a typical concrete example of the factural correspondence.

The second alternative is the conventional assignment of a corresponding member of a second series to each member of the first series to the exclusion of all other assignments. This is in Mr. Johnson's terminology a *factitious* correlation, i.e., "not inherent or objective, but arbitrarily imposed by the counter."[1] Factitious correlation takes place in counting, where the order in which the items to be counted is irrelevant provided each number is applied in the ordinal succession to one item only. Besides the case of counting, a factitious assignment occurs whenever there is a demand for a correlation between *finite* groups which are not naturally or internally interconnected. "Apart from this *factitious* coupling, there is no one-one relation, subsisting between any item of the first set and any determinate item of the second, that would not equally subsist between the given item and any *other* item arbitrarily selected from the second set."[2] In other words, both sets must be artificially arranged prior to the coupling of their items. And, of course, they must be finite in order to be thus treated.

A factitious correlation deals with finite collections because it is based on enumeration or counting. Infinity evades enumeration. Hence a factitious correlation is

[1] W. E. Johnson, *Logic*, Vol. II, p. 156.
[2] *Ibid.*, p. 159 f.

impossible when infinite groups are concerned. It follows as Mr. Johnson expresses it, that "the only mode of establishing numerical equality between *infinite* classes is to discover *factual,* or more specifically *formal,* correlations."[3]

But if there is no factual correlation between finite collections, why should infinite classes be in a privileged position? To be consistent Johnson should have applied to infinite collections the same consideration which he maintains concerning the finite sets, i.e., that there is only a conventional basis for coupling two items which belong to different sets.

If Mr. Johnson refuses to hold to this concerning infinite sets, it is because he has admitted already that they cannot be correlated factitiously. Were he to concede now that they cannot be correlated factually either, it would follow that they are not correlated at all. But this is not conceded because it destroys the supposed equality between the whole infinite series and its proper part.

Thus the assumption that there is a factual correspondence between infinite sets seems to be advanced *ad hoc* and without any warrant. In fact, as it happens, infinity is not only not in any better case than finite collections in respect of a factual correlation but is in a decidedly weaker position. For infinite sets have no means of excluding the claims for one-many or many-one correlations, an exclusion which *is* possible in the equalizing of finite collections because of the actual exhibition that each unit of a given set has one and only one correlation of another set. Such an actual exhibition of correlation between two infinite series is impossible. Their correlation is only a rule or requirement to be correlated in a certain way. But then there is no definite reason why one rule of correla

[3] *Ibid.,* p. 156.

tion should be preferred to any other. And because of this indefiniteness it may appear that two infinite collections are at once in one-one and in one-many correspondence. In other words, they lack the condition of uniqueness of a one-one correspondence which alone could guarantee equality. Since they can be arranged both in one-one and one-many correspondence *they lack the factual correlation.* Since they cannot specify their order of arrangement *they have no factitious correlation either.*

But is it a fact that two infinite collections may be arranged both in one-one and in one-many correspondence? In answer to this question I would refer to Mr. R. H. Dotterer's argument.[4] Mr. Dotterer proposes to consider the same two series that were exhibited above as in one-one correspondence correlated differently as follows:

Case II 1, 2, 3, 4, . . .
2, 4, 6, 8, 10, 12, 14, 16 . . .

Mr. Dotterer says that this one-to-two correspondence is " . . determined by clear and definite rules of exactly the same kind as, although a little more complicated than, the rule which determines the one-to-one correspondence. In case II let the rule be that the second of the two terms paired with any one term of the whole series shall be four times that term. . ." It is shown next that different other correlations between the two series are possible. Hence it follows ". . that the whole series stands to this proper part in these *various* relations of correspondence *in exactly the* same sense in which it stands to it in the relation of *one-to-one* correspondence."

This then disproves the factual equality of infinity to its proper part. Since the *factitious* correspondence has been denied *ab initio* the whole basis of the new mathe-

[4] *Cf.* "The Definition of Infinity," *Journal of Philosophy,* Vol. 15, 1928, p. 294 f.

matical definition of infinity collapses. What really takes place is not *the* equality between the whole and its part but any correlation whatsoever or, what amounts to the same thing, in themselves the whole and the part do not stand in any correspondence whatever. The protean trick on the part of infinity in assuming various sorts of correspondence proves nothing but *indefiniteness.*

And the reason for such indefiniteness is obvious. There is no end, in the direction to the right, of the infinite series concerned. Accordingly this direction indicates an inexhaustible supply of fresh numbers. And because the supply is inexhaustible any sort of correspondence to a given series may be established. For one may always draw new numbers to be set in correspondence either individually or by couples or even wholesale. The borrowing of these numbers never brings the source of supply to an end. Infinity is a hydra. You think you cut off its head, but you are mistaken. A new head grows in place of the old one.

Thus if different correlations (including the one-one correspondence) may be imagined between an infinite collection and its proper part, it is because the *endlessness* of the series concerned is presupposed. Hence the new definition of infinity cannot get rid of the old negative definition, but tacitly involves it. This is the first conclusion of the present paper.

III.

In spite of the preceding argument a partisan of the cantorian infinity may insist on the possibility of *neglecting* all the correlations but one, namely, that on the basis of which there is a one-one correspondence between the in-

finite whole and its part. But is there such a correspondence, after all?

In order to answer this question affirmatively one has to maintain that there *actually is* an *infinite whole* as well as an *infinite* part.

These two infinite rows of a whole and of its part must be imagined as running parallel to each other so that one can pick up any item of the first row and find at the same time the corresponding item of the second row. These two organized armies of numbers, which are facing each other and waiting patiently to be called forth, offer a curious picture of which there is in my judgment no original in actuality. And the armies of these ghosts, even if their number were infinite, would make, in the estimation of a militant logic, a negligible quantity.

That such infinite rows are fictitious is proved by the fact that actuality displays only finite entities. Actuality may even be defined as a limitation of the realm of possibilities. And limitation means finitude. But the justification of this definition of actuality would lead beyond the scope of the present essay. It suffices to point out that besides a meeting of finite entities all that actuality exhibits is an indefinite possibility of proceeding towards new finite entities. And this is exactly the meaning of the indefinite or negative "infinite": i. e., the possibility of advancing beyond any assigned entity to other entities. It does not follow by any means that such an indefinite is actually infinite.

Sometimes, however, the fallacious inference is made that the possibility of an endless advance implies an actual infinity. The famous "locus" of such an inference is, of course, Lucretius's proof of the infinity of the world in space. If the world were finite one could imagine a man on the edge of the world throwing a dart forwards. And

since there is no obstacle to the flight of the dart, the latter will move beyond the supposed limits of the world. Which proves ipso facto that these limits were not real limits.

The argument evidently identifies the possibility of advancing beyond any actual limit of space with the actual infinity of space. But such an identification is by no means necessary.[5] The advance beyond the limits of the world does not prove that these limits were unreal. It proves only that they may be removed along with the flying dart. In other words, the flight of the dart creates a new actual space. For space, in general, may be considered as the function of the interactions in this world. And there is no reason why the range of the interactions should not increase in the course of time. The world growing older may well expand in space.

Of course, that creative motion of the dart presupposes a possibility of motion, i.e., a possibility of space. But this possibility should not necessarily be imagined as an actual *empty* space spread ad infinitum. An empty space is a pure fiction. I do not mean that the possibility of space is nothing, but that space is not empty. For space, in order to be space, must be actual, i.e., filled up with real entities.

The reason for this is as follows. Space is something which has spatial characteristics or entities, such as points, lines, volumes and so on. But a spatial entity cannot properly be characterized actual unless it is actually exhibited. And that actual exhibition is always an outcome of some interaction in the concrete world.

Let us take, as an illustration, the simplest spatial entity—a point. Now, it is clear that a point is actually exhibited at the intersection of two lines. But the question

[5] Of course, in respect to a non-Euclidean space Lucretius's difficulty might not have arisen at all.

is whether or not this point actually existed before its exhibition.

In any case it must be granted that an invisible existence on the part of a spatial entity is a queer mode of being. Such a spiritualistic status could not be explained even by playful reasons. For even if all the points along a line were playing "cache-cache" that would imply the possibility of finding them all.

But the curious thing is that they cannot all be found. In order to find two or more points one has to separate them by a linear interval. In general, if a point is found it is because its surroundings appear to be different from points. The prerequisite of a point is the intersection of two *lines*. But even if the intersecting line moves continuously parallel to itself, it will not continuously exhibit new points along the intersected line. For the continuity of motion will leave no linear interval between the points and they will, so to speak, blend together. Thus all these points, when unveiled make only a cemetery of points. In fact, they make up the intersected line itself. Of course, it does not follow that the points blended together into a given line are nothing at all. One does not create a point from nothing by intersecting a line. But it follows that before the intersection takes place the points are not actual entities, for they are not yet individualized. An actual point is an individual emerging from the state of fusion with other points. It is a selection, which presupposes that the neighbouring points are, as it were, neglected and suppressed.

The possibility of an entity, which cannot be called nothing, and yet is not an actual being either, may be demonstrated in the realm of time as well as in space. The events of the future are precisely in this predicament. For

one cannot flatly deny the future. Mr. Broad's failure in maintaining the nothingness of the future is sufficiently instructive. It shows that in a sense the future must be given and, consequently, the totality of time, though neither the future nor the totality of time is given in the same mode in which an event may be *actually present.* If this last were the case the advance of time would be impossible. Everything being present, it could advance nowhere. In other words, though *any* event may occur sooner or later, not *all* events can occur in the sense of an actual happening. If they could, time would commit suicide! Thus *all* events are not actual; they simply indicate the possibility of *any* actual occurrence. One must guard against the confusion of "all" and "any."

This last consideration is particularly relevant to the problem of correspondence between infinite collections. It seems to me that an analogous confusion between *"any given"* and "all possible" members of a series takes place when the one-one correspondence of an infinite whole to its part is contended for. Returning to Case I, the functional correlation of *"any"* number in the row A, with some even number in the row B cannot be extended to *"all"* numbers, for that would presuppose the question at issue, viz., the totality of numbers. Of course, it is true that any *given and finite* member of the series of integers may be coupled with an even correlate of the row beneath. This is possible because one can actually proceed beyond any assigned number. In other words, it is possible because there is no completed totality of numbers. The Aristotelean conception of endlessness is decisively important here. If there were a greatest number, we could not find its double, since the greatest number would close the series.

Thus any integer finds an even correlate because it is

finite and, consequently, does not close the aggregate of units. Now it is certainly true that if any given, i.e., actual and finite number has an even correlate then all *given* numbers also can be set in one-one correspondence to even numbers. But it does not follow at all—and this is the most important point—that if any actual and finite number has an even correlate then all *possible* integers have even correlates. For, as I suggested above, the state of possibility of entities is different from the hiding of actual entities. And to treat all possible numbers as if they were actual entities, though not yet revealed, would be a fallacy. At least, it certainly would be a confusion of types to treat the whole class of numbers in the same way as its members.[6]

Undoubtedly the property of having a double correlate is a functional property. And this functional property is hereditary. But only inductive or finite numbers possess hereditary properties. The infinite class, on the contrary, is *non-inductive,* according to the partisans of the new definition of infinity themselves. That is to say, infinity escapes the hereditary burden of a progression, in which a hereditary property is carried from one member to the next. Infinity "has no immediate predecessor, because there is no greatest finite number."[7] Therefore infinite number is free from any obligation to mathematical induction. But then the property of one-one correspondence which may be extended to any assignable or finite number of a series cannot be attributed to an infinite number.

In other words, the very application of the rule of one-one correspondence is based on the inductive character of the series and does not take place when infinity

[6] *Cf. Principia Mathematica,* p. 37; "Whatever involves *all* of a collection must not be one of the collection."

[7] Russell, *Scientific Method in Philosophy,* p. 195 ff; *Intr. to Math. Philosophy,* p. 80.

is concerned, since the latter is by definition non-inductive. It follows that one-one correspondence cannot be established between infinite series for they are not actually assignable.

IV

In spite of the fact that infinity is not enumeratively or inductively assignable, the cantorians maintain that an infinite number may be assigned in *intension.* Thus Mr. Russell holds that ". . there is only one practicable way of defining particular infinite classes, namely by intension."

The practicable character of a definition by intension consists in the fact that it may dispense with the enumeration of the instances of the entity to be defined. But an important proviso must be added: this is true only so far as finite entities are concerned.

It must be true concerning finite entities, for otherwise the latter would be unintelligible in the case of an indefinite or of a null number of instances. For example, connotative definitions may make intelligible the notions of "atoms" and of "dragons," though the former are innumerable and the latter are non-existent. The number of instances is simply irrelevant to the intelligibility in *intension* of a finite entity.

This is true even as regards finite numbers themselves, at least on the basis of the class theory of numbers. But if one turns to the definition of infinite collections one finds the situation puzzling.

In one sense the Cantorian definition of infinity is clearly enough given in intension; the whole infinity is discriminated from its parts. In Case I above, for example, the second series obeys the general rule of leaving out the odd numbers; hence it is a priori a part of the

complete series of integers, including both even and odd members. Thus the part-whole distinction between infinite collections can be established in intension.

But the other demand of the definition, according to which the whole and the part are set in one-one correspondence cannot be demonstrated in intension, since it is based, as I have shown, on an enumerative or inductive coupling of any finite number with its functional correlate. It cannot be demonstrated in intension because by definition in intension a whole is greater and not equal to its part. Hence in order to show that this definition in intension may have an exception one has to recur to an actual exhibition, i.e., one must show the exceptional case in extension. In case of infinity the definition in intension must itself refer to an exhibition of actual endless series.

This exhibition, roughly speaking, takes place in the following manner. First, one imagines a diagram of a whole-part relation, which is, in accordance with the definition in intension, an inclusion of the part in the whole: Next, one recalls that the *endlessness* of the part precludes its having rigid or permanent boundaries. The radius of its circle is perpetually increasing so that its swelled boundary may, so to speak, catch up with the outward circle of the whole. Hence the equality of the part to its whole is proclaimed. To be sure, the whole can swell up in its turn. Yet it can be overtaken again by its growing part. There is then a *process* of shifting boundaries. The part is equal to the whole in the making, but not to the whole ready-made. If the definition in intension indicates this kind of "equality," then it is only a rule according to which an actual endless series may be constructed. But such a rule of constructing is essentially different from a connotative description of an already con-

structed entity. The latter being a static system may be described. But in the absence of fixed boundaries the description of the situation would be similar to a description of a face which has no features. If a rule of constructing a series is interpreted as a description in intension of a completed series, then the rule is violated because there is nothing to construct.

To illustrate this let us consider Russell's example of a state, where polygamy and polyandry are strictly prohibited. This means that by definition in intension the number of married men is exactly equal to the number of married women. That is to say, inequality is positively ruled out a priori. However, imagine that the number of married men and women is infinite, which is not impossible a priori. Then on the basis of the Cantorian theory one might select all the wives and put them in one-one correspondence to all the members of the married couples. It would appear that there are two women corresponding to each married woman. A series of surplus women would be, as it were, miraculously created. This curiosity might be approved by men but it would certainly overthrow the constitution of the state.

The absurdity of the situation shows that operations with endless series defy a definition in intension. For a definition of collections by intension either indicates an equality or a whole-part relation (i.e., inequality) but not both. Hence if we grant for a moment that endless series are at once equal and unequal, either equality or inequality must be established in extension and not in intension. In fact, as shown above, equality is established in extension. And this consideration solves the intolerable paradox of the new definition of infinity. The infinite whole and its proper part are equal and unequal in different senses.

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The logical fallacy of the cantorians lies in the confusion between infinite *totalities,* i.e., entities in intension and endless *series* unfolded in extension. It is true that the indefinite series which leave a possibility of an endless progress were actually exhibited. And no matter how different in intension these series were, they all presented an equality in the sense of the endless extensibility.

But this endlessness, which really means an absence of totality, was mistakenly interpreted as an equality of totalities defined in intension. That mistake becomes apparent, however, because the proposed definition in intension is unintelligible unless an indefiniteness in extension is presupposed. For by definition in intension a whole is *necessarily* greater than its part and to maintain an exception it is *necessary* to recur to a different kind of demonstration, viz., to extension.

Thus it turns out that whenever one treats infinity in intension one must exhibit an actual case of endlessness or indefiniteness. And this may be taken, in my opinion, for the basis of a definition of infinity. That is, *infinity may be defined as a collection which has an intension dependent on the extension.* This definition distinguishes infinity from all finite entities.

And it appears also that it is couched in purely positive terms. In fact, however, it is not so, because in order to be understood it *leads* to an actual demonstration of an instance of endlessness. Yet there is at least one advantage in the proposed definition over the Cantorian. My definition only *leads* to an exhibition of endlessness, whereas the Cantorian *presupposes* it.

This advantage is due to the fact that the concept of intension in itself does not present immediate evidence for the independence of extension in the case of finite entities. This independence must be established mediately. To

illustrate this one has only to recall the endless controversies concerning the status of Universals.

On the other hand, the Cantorian definition is based on the violation of the generally admitted meaning of the "part-whole" relation. And since this violation amounts to a violation of the logical law of excluded middle (interpreted in extension), the Cantorian definition could be discarded *ab initio,* unless it *started* with an exhibition of an actual case of such a violation. It follows that the Cantorian definition *presupposes* endlessness.

V

I do not claim that my definition has any significance in mathematics. Apparently the Cantorian definition satisfies the mathematicians and, therefore, must be retained as an operative and pragmatic instrument. But I think that my definition may have a certain philosophical importance. For it leads to a search for those cases where intension implies extension. And once these cases are found their logical conditions may be investigated. Hence the possibility of clearing up the situation which involves infinity.

The present essay cannot undertake an explanation of infinity because that would require lengthy discussions. All that can be done here is in the way of suggestion and conjecture.

With this preliminary remark in mind let us, in the first place, turn to the most familiar illustration of infinite series, viz., the infinity of points on a line. The fact that all lines, no matter how short or long they are, possess infinities of points is supposed to illustrate geometrically that in infinity a part may be equal to the whole.

But it is overlooked that the inequality or part-whole relation is concerned in these illustrations with lines and not with points, whereas "equality" concerns the number of points. Accordingly, it does not follow that inequality of lines entails inequality between the collections of points. This would be the case if the length of line were built up by accumulation of points. But it cannot be so for the simple reason that length is a dimension, whereas points are dimensionless. Since all points have a zero-dimension it is clear that even an infinity of points would yield nothing but zero length.

Hence when unequal lines are compared as to the "equal" number of points that they contain, this comparison loses sight of the lines as such. A point is a cut on the lines. And, of course, one may cut any line as long as one pleases. But thus cut, the lines are mutilated and, therefore, falsified. In other words, the endlessness of the series of points is revealed only when one descends from the level of linear dimension to the level of zero-dimension. In terms of the former the supposed equality of infinite collections can never be demonstrated.

It will be easily found that the same may be generalized as to any dimension of space. That is to say, on the level of a certain dimension its unequal sections cannot be equal. It is only in the language of the lower dimensions that these unequal sections may appear to contain an infinity of constituents.

This necessity to lower the dimension or to descend the ladder of levels in order to encounter endlessness is analogous to the necessity of translating intension in terms of extension which I hold to be characteristic of infinity. And the analogy may be pushed one step further. The level of intension is, so to speak, of a higher dimension than the level of extension. For just as a geometrical

entity of a higher dimension runs through the geometrical entities of a lower dimension and yet *transcends* them all, so a meaning in intension is exemplified by all the entities making up its extension and yet *transcends* them. The reason for the latter transcendence is that intension belongs to the level of universals, whereas extension deals with particulars.

I call attention to this point, because I think that it suggests a generalization concerning the meaning of infinity. That is, I think that infinity may be explained by the relation (or rather operation), which makes up the connection between the levels of universality and particularity. Whenever the attempt is made to express a universal in terms of particulars an endless or infinite way is open.

A universal is not, like a particular, confined to a definite spatio-temporal spot. A universal is able to perform what Cagliostro once claimed to have achieved, i.e., a simultaneous appearance at different gates of existence.

On the other hand, the particulars must have a "make-up" for such ubiquity, if they are to translate universality in their own language. But the only means to do this would be to annex new regions of space and time, at which a universal might appear. This expansion in space and time is achieved by an *accumulation* of particular instances. The plurality of instances is thus, as Plato has noted it, an imitation in terms of number of the universal plan.

In so far as this imitation is skillfully done what takes place is the *recurrence of a universal.* Recurrence is, indeed, the connecting link between universality and particularity. For recurrence, in order to have a meaning at all, *must be actualized.* If nothing ever recurred, then the very conception of recurrence could not arise. By a

peculiar ontological argument, recurrence leads to particular recurrent occasions.

On the other hand, universality is also subject to recurrence. For a concrete occurrence is distinguished from recurrence precisely because the latter is a particular occasion *plus* an element of universality, which repeats itself on many occasions. Hence recurrence implies universality. And the reverse is also true: universality implies recurrence. I am not denying that a universal is indifferent to the frequency and location of its manifestations. I agree with Whitehead that a universal is externally related to the concrete occasion. But this indifference or externality should not be extended too far. Though a universal is externally related to *any* particular instance, it does not follow that it is externally related to *some or other* manifestation. A universal must be exemplified sometimes. Otherwise, as a pure abstraction, it would lack any actuality. If it did not actually recur at different occasions, there could be no reason whatsoever to distinguish its uniqueness from the uniqueness of the particular.

The plurality of repetitions is, then, the way to express in number or in extension that which is essentially unique and intentional. Thus recurrence is the source of number. But it is not the source of finite number only. For it involves endlessness and indefiniteness. And there are two reasons for this. The first lies in the nature of universals. As already observed a universal is externally related to any particular occasion and yet is compelled by "recurrence" to take place in some instance or other. In order to make the conjunction of these two conditions possible, "recurrence" must present an inexhaustible and unlimited field of manifestations. That is, the freedom of selecting an incarnation cannot be restricted.

The second reason is the ontological difference between the levels of universality and particularity. Though recurrence is a medium, there is no perfect communication between the two. For the plurality of instances always falls short of the uniqueness of a universal. The accumulation of particulars may imitate the catholicity of universals, and yet the imitation is never perfect.

And this fact that there are ontologically irreducible levels—is, perhaps, the meaning of infinity. It does not express an actually infinite series. It simply shows the impossibility of translating one ontological level in terms of another which lacks some formal element of the first. The lacking element is in vain replaced by an endlessness of efforts to reach its universality.

The universal cannot be crucified on a finite cross: it is resurrected in recurrence.

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FRANCIS BACON AND THE MODERN SPIRIT[1]

RECENT psychology and educational theory manifest tendencies to assume as well as to conclude that the self is an aggregate of affective-motor dispositions and habits, each of which exists in essential independence from at least some of the others. The task of character education is then construed as the cultivation and training of separate interests in such wise as to add virtue unto virtue. Man's moral nature is viewed as a composition of relatively distinct virtues. In contrast hereto are the more monistic doctrines of man and of morality. These have taught that all the various virtues spring from a single root. They have contended that excellence of functioning in man's diverse relations to physical and social situations reflects a single spirit. Thus, the Cynics held that virtue is essentially one and is entirely comprised in wisdom, that every act of the wise man is in accordance with all virtue. So also the Stoics taught that he who has one virtue possesses them all. Earlier still, indeed, the father of scientific ethics himself had defined virtue as knowledge, and had described the several virtues in terms of valid insights into the nature and the significance of the various demands upon human action. Nor has the theory of the unitary character of the moral life lacked advocates among the modern ethicists of western Europe

[1] Read before The Baconian Club of The State University of Iowa, on March 28, 1930.

and America. William Wollaston, for example, attempted to demonstrate that truthfulness is the central principle of all good conduct; and, in our own day, America's most erudite philosopher, Josiah Royce, argued with fervor that the heart of all the virtues is that willing, practical and thorough-going devotion to a cause which might fittingly be called loyalty. In essential agreement herewith, a distinguished member of this Club, in the introductory chapters to his valuable series of volumes on *A Guide to Literature for Character Training*[2], has declared: "There is just one sin, that of selfishness. All the blemishes, little and big, root down in that." When we look aside from technically equipped moral philosophers and yet do not leave the ranks of profound seers, we find many who would subscribe to Carlyle's dictum that a carpenter might quite possibly break the entire decalogue with a single stroke of his hammer.

But even if we accept an organismic doctrine of the moral life of the individual, may we do the same for the complex civilization or culture of an epoch in a broad area of the world? Is it defensible here to speak of an animating spirit or operative principle that manifests itself throughout the diverse human interests and institutions and the various lines of social endeavor and evaluation? Perhaps the meaning of these questions would be clarified and a suggestion given for their answer if we were permitted the use of an anecdote—one which need not arouse scientific suspicion merely because it involves an element of humor. It is said that a teacher in an institution including students of many different nationalities once prescribed an essay on the elephant. From a sturdy, self-reliant English lad recently returned from vacation she received, in due course, a paper entitled "Hunting

[2] Vol. I, p. 7.

Wild Elephants in Africa." A somewhat cocky, red-headed Irish boy, on the other hand, prepared an account of "The Fighting Elephant," while a polished and courteous French pupil, after a visit to the parks of Paris, submitted as his theme "L'amour chez les éléphants." A dreamy-eyed and somewhat mystical Russian who had meditated at a boulevard cafe presented his reflections on "The Ideal Elephant"; an industrious and spectacled German student, after numerous visits to the zoo for careful anatomic measurements, and after repeated journeys to accessible libraries, staggered forward to the teacher's desk with a load of manuscript bearing the caption, "An Introduction to the Study of the Elephant." Long before any of these papers were turned in, however, a bustling and highly efficient American boy had confidently handed to his teacher a snappy and well organized paper on "Bigger and Better Elephants." Now doubtless the specific aspects of the elephant and his life which appealed to the several students reflect to some extent individual eccentricities. But do they not also in some measure signify characteristics that with some sharpness demarcate the cultures and interests of the national groups represented by the students? Is it not true that one who was familiar with these national cultures and with the general circumstances of the case would readily be able to specify the nationalities of the several writers upon a mere reading of the titles of the essays?

Cases are not lacking of peoples whose diverse fields of interest and activity expressed, throughout long periods of time, a single dominant set of values. Look, for example, out of a train window in India early in the morning and you will see among the natives many who are assiduously cleaning their teeth with a sharpened bit of wood; and you will note in the village pools numbers of people

engaged not merely in washing the loin cloths about their persons but more especially in purifying their bodies. Among your fellow passengers or the multitudes of people on the station platforms, as apparently everywhere throughout the country, you will find adolescent girls with babies in their arms; and, if you pursue a line of inquiry, you will be told of the early age at which girls are expected to marry, of the severe sufferings commonly attending childbirth and other experiences of married life, and of the horrors of widowhood. In your train compartment there may be a Brahmin travelling with a container of food and cooking apparatus, through whose use his private servant prepares all the cooked food that his master may eat on a journey where there is uncertainty as to whose hands might otherwise touch his food. At the railway stations you will observe separate drinking founts and dining rooms for Mohammedans, Brahmins and Hindus of a lower caste. Now, varied as are these features of Indian life and culture, they are not radically detached from one another. They are not isolated and accidental phenomena but are alike grounded in that dharma or highly articulated and yet unified order of life called Hinduism. Beliefs, temples and their gods, social and political structure, family organization and customs, along with activities of personal life are sustained by a single root. To modify any of them is therefore not a simple matter. Any significant change would entail either a loosening from the whole or a radical transformation in the character of the dharma.

But the point thus illustrated could have been presented without going so far afield as India. Consider medieval Europe, when Christianity was thought to be a revelation of the transcendent, and its organ, the Church, was looked upon as mediating all that was of real moment to

man. Here also a central interest dominated practically all the significant phases of the life and culture alike of the individual and of society. The social and the political conscience were moulded by the Church, and the several lines of temporal pursuits, including agriculture, trade and education, were under her control. She held the rôle of arbiter not alone in conduct but also in taste and thought. The kingdoms of this world were by it assigned their respective provinces and rights, and the realm of truth was ruled by it with no less rigorous a hand. She was for a considerable period the uncontested ruler over all the domains both of idea and ideal.

Hinduism and the civilization of medieval Europe, thus, may be cited in confirmation of the thesis that the expressions "spirit of an age" or "spirit of a people" are not mere tinkling sounds. But, it may be urged, do they have meaning in reference to the civilization of modern and especially contemporary western Europe and America? Is not perhaps our present life so complex and so differentiated, and are not its several elements so thoroughly independent of one another, that one may not speak of a unifying tendency or a common goal? Or are we on the contrary justified in saying that in this case also there prevail a general standard of appraisal and a dominant set of values? In short, is there a modern spirit?

Surely this question may fittingly be pressed, and the answer is neither obvious nor demonstrable. Nevertheless, there is firm ground for the thesis that the modern world of which we ourselves are a part has exhibited, and here in America especially still exhibits, a devotion to a very widely accepted objective of action and criterion of judgment, and that this fact gives it a relatively unique character. In so far as this may be the case we may speak of "the modern spirit." If we would identify the latter may

we not find our cue in the subject which the American lad gave to his essay on the elephant? "Bigger and Better" would seem to be the watchword of modern life in western Europe and America. These terms express our aspirations in the several fields of endeavor, and furnish our standards for evaluating the various programs and projects that come into scrutiny. In so far as it is at all permissible to allege the existence of a modern spirit, this may confidently be said to center about the idea and the ideal of progress.

Confirmation hereof thrusts itself upon us no matter whither we turn. Organized religion increasingly justifies itself and its heavy drains upon the energies and resources of men, by reference to its rôle in lightening human burdens and promoting a better era of history. Theology is veering so strongly into the channels of humanism that to multitudes of deeply reverent thinkers even the theistic doctrine seems extremely anemic, if not even moribund. Educational institutions and activities are extolled for their revelation to imagination of a fairer social order, for firing the zeal and hardening the determination of individuals to achieve such an order, and, more specifically, for equipping them with a knowledge requisite for success in this enterprise. The aim even of Liberal Arts colleges and of universities, we hear it proclaimed—even when the objective for the moment is not the acquisition of endowments—is service, and service of a predominantly social sort, affecting the removal of present ills and the inauguration of a bigger and better future for mankind. Law and judicial procedure are believed healthy when they direct themselves not so much by assumedly immutable natural or spiritual laws and by considerations of inalienable nature-or God-given rights of individuals, or by so-

lidified precedent, as by conjectures respecting the probable consequences of legislation and judicial decisions. Civilizations today are rated according to the principle of progressiveness. Such of the older ideals as continue to command allegiance are those that have found new strength, to use a phrase of Bury's, "by attaching themselves to Progress."[3] And thus it is, to quote further from Bury, that the "conjunctions of 'liberty and progress,' 'democracy and progress,' meet us at every turn. Socialism, at an early stage of its modern development, sought the same aid. The friends of Mars, who cannot bear the prospect of perpetual peace, maintain that war is an indispensable instrument of Progress. It is in the name of Progress that the doctrinaires who established the present reign of terror in Russia profess to act. All this shows the prevalent feeling that a social or political theory or programme is hardly tenable if it cannot claim that it harmonizes with this controlling idea."[3]

The idea and the ideal of progress are commonly taken so for granted by us that we fail to realize how distinctive they are, and how novel in respect to the hopes and enthusiasms which they engender, to the ideals, along with the judgments, which they control, and to the programs which they determine. It will aid our perspective if we recall that Ecclesiastes voices a widespread ancient belief in the statement: "That which hath been is that which shall be . . . ; there is no new thing under the sun." Even Marcus Aurelius wrote: "The rational soul wanders round the whole world and through the encompassing void, and gazes into infinite time, and considers the periodic destructions and rebirths of the universe, and reflects that our posterity will see nothing new, and that our ancestors saw nothing greater than we have seen. A man of forty years,

[3] J. B. Bury, *The Idea of Progress*, p. viif.

possessing the most moderate intelligence, may be said to have seen all that is past and that is to come; so uniform is the world."[4] Common among the ancients were such beliefs as that history and the processes of nature move in cycles; or that the golden age is an epoch in the past, and that the best that may be expected by us is its recovery; or that the good, so far from being—as we now say with deep meaning—the enemy of the better, is something which, when once obtained, should by every effort be preserved.

Time, for Plato, was not an opportunity for unlimited advance toward the ideal, but, like space, was a medium which by its very nature thwarts the clear and the full manifestation of the perfect. Be it noted that the conception of progress involves that of movement as well as of time. It is therefore not without significance that even for Aristotle motion and rest were placed in opposition, and that this antithesis persisted in scientific thought until the day of Galileo, when this great precursor of the modern spirit represented motion as fundamental and rest as but the limit thereof. Now Aristotle indeed stressed the concept of development. He found throughout nature a nisus to the good and to participation in the divine life, and he interpreted natural existences in terms of a hierarchy in which the lower were the basis and potentiality of the higher. Nevertheless sight must not be lost of the fact that even he did not think of the different stages as successive in time. In the case of his social philosophy, to be sure, he described as later in time that which he also deemed both logically prior and superior in worth, namely, the State. Yet again he stopped short of a doctrine of progress. He never proceeded to the thesis that history represents a universal upward movement, or that advance

[4] Quoted by Bury, *op. cit.*, p. 13.

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in nature and status is possible generally as regards men and social conditions. Throughout he was haunted by the traditional ideas of cycles, and of alternations between periods of decline and of advance; and he espoused the view that the capacities of human nature as such, and likewise those of individuals, so far from reflecting cultural factors, are essentially fixed *ab initio*.

The point involved in the Semitic story of the tower begun at the place which later received the name Babel was not without its parallels. Those mortals who were of such boundless conceit that, in the words of Genesis, "nothing will be restrained from them, which they had imagined to do" and who therefore aspired to reach the very elevations of heaven, were smitten by the divine powers themselves. In the thought of the Greeks, similarly, *moira* had definitely bounded the powers of man and thus delimited him from the superhuman. In consequence, the notion of a continuous advance towards perfection either in knowledge or in happiness was deemed both untenable and irreverent, as involving an encroachment upon the ultimately controlling power of the cosmos. Dean Inge thus seems entirely secure in his generalization that the ancients generally "would have thought the modern notion of human perfectibility at once absurd and impious."[5]

To be sure we here and there find optimistic doctrines of social evolution even among the ancients. This is the case, for example, whether we look to the Epicureans or to the Stoics. The former, though generally skeptical as regards the value of civilization and aspiring primarily to rendering tolerable the lot of the individual, had their Lucretius, who used the word progress—and was apparently the very first thus to use it—in our modern sense, and who taught that, while stagnation and even retrogression

[5] Inge, *The Idea of Progress*, p. 6.

were not completely absent, the changes within human sociey as a whole exhibited progress. The Stoics, like the Epicureans, were predisposed to a philosophy of resignation. Nevertheless we find among them a Seneca, who believed in the progress of knowledge. And yet, be it observed, the knowledge to which Seneca referred, while indeed capable of affording glimpses into the divine regions, was nevertheless incompetent to ameliorate otherwise the conditions of personal and social life. Hence, as Bury has pointed out, Seneca, so far from even "adumbrating a doctrine of the Progress of man" even held to the "theory of degeneration and the hopeless corruption of the race."[6]

The regime of medieval Christianity, as that of Hinduism throughout its history, we find dominated by the ideal not of change but of a fixed order. Influences emanating from theology, from Greek doctrines of a moral order, and from the Stoic conceptions of the order of nature that filtered down through Roman jurisprudence, deeply impressed themselves upon the mentality of the Middle Ages. In their science and their philosophy, too, the dominant feature was closely locked, coherent system—the temper was rationalistic. Moreover, the regard was focused upon a yonder world, and this made quite impossible the ideas and outlook that subsequently became common possessions in the notion of progress. Before the latter could arise and flourish there must come a shift of interest to the values and possibilities of the empirically experienced world of nature and of history, to the life of the here and the now; there must come also an intensified emphasis upon the fact and the significance of movement and time, as contrasted with rest and the timeless, of change as contrasted with the invariable; and furthermore, there must come striking evidences of man's power,

[6] J. B. Bury, *op. cit.*, p. 15.

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under given and attainable conditions, to effect such far-reaching changes in his world as to win emancipation from subjection to its forces, if not indeed gradually to gain an effective mastery over them. The story of these changes would involve chapters on the recovery of ancient civilization, with its striking demonstration of a rich cultural life outside the pale of the Church, and of intellectual wealth amassed through the activities of human reason and imagination when pursuing their own laws. It would include accounts of the discoveries of new worlds, with their stimulus to imagination and curiosity, no less than their promise of limitless wealth. It would describe political struggles, and the aroused ambitions for lives of power and for free expression of personality. It would take cognizance of rising towns which vied in industry and technical skill and zealously sought new artifices, machines and implements of war to promote their economic and military ends. It would tell of the inventions that conquered distance and thus facilitated travel and the exchange of both goods and ideas. It would stress the successes of those thinkers who sought to master the principles of such changes and of inventions, to develop their logic, to construe in their light the meaning and the ideals of human life—yea, by their aid even to interpret the cosmos.

In saying this, and in underscoring the novelties in the modern spirit, we would not deny those large continuities that make of history a story. In some sense the developed religious consciousness is optimistic and regards with confidence the world as ruled by its God; and thus, in so far as considerations of the future are involved, it has faith in the triumph of the good, even when it advances no theory as to the manner thereof, and does not think of the advance as steady and unbroken. Like certain types of

philosophy, it inclines to envisage a cosmos which securely harbors ultimate values. When, then, reality is or comes to be viewed as qualified by time, the doctrine of an inevitable increase in values, under the operation of metaphysical principles or of the divine agency, speedily makes its appearance. Similarly, the cosmology of the Greeks was at least in large part dramatic. As Whitehead has pointed out, it "conceived nature as articulated in the way of a work of dramatic art, for the exemplification of general ideas converging to an end. Nature was differentiated so as to provide its proper end for each thing . . . Nature was a drama in which each thing played its part."[7] Moreover, in some degree all voluntary action, particularly when battling with stubborn obstacles, presupposes some dedication to a better future and some belief in the possibility of achievement. Thusfar such action, especially where it involves the participation of co-operating individuals, presupposes the idea and the possibility of progress. The latter, therefore, may in some sense and measure be credited to all men; and the religious consciousness of medievalism was further convinced of the over-ruling power for good in the cosmos at large. What was needed, however, to give to such ideas the quality of the modern spirit were a number of unshakeable convictions—convictions of the ultimacy of time and change, with their bearing upon human hopes and possibilities; of the continuity of the future with the conditions of the past; of the capacity of man, under the guidance of thought, to transform the circumstances of life, both individual and corporate, and even to add a cubit to his stature; of an ethical responsibility to discern ills that require remedy, and to devise means at once curative and preventive. Joy in

[7] A. N. Whitehead, *Science and the Modern World*, p. 11.

life and faith in nature, coupled with a sense of human power and human responsibility, came to be forces that fortified the conception of man's unlimited perfectibility.

But what is Bacon's relation to this ideal of progress that did so much to shape modern culture as its indwelling and informing spirit? First of all this: Bacon was himself thoroughly imbued with the progressist soul. Now, "the kind of philosophy one chooses depends upon the kind of person one is. For philosophy is not like a piece of furniture which may be selected and discarded at will." This remark of Fichte's is apt indeed in the case of Bacon. And in understanding the man who generates a corresponding type of philosophy, it is noteworthy that precisely in so far as he possesses penetration and sensitiveness will he be alive to the deeper currents of his age. Now, Bacon's was a day in which printing, gunpowder and the magnet had made their appearance and these, in Bacon's words, "changed the whole face and state of things throughout the world; the first in literature, the second in warfare, the third in navigation; whence have followed innumerable changes; insomuch that no empire, no sect, no star seems to have exerted greater power and influence in human affairs than these mechanical discoveries."[8] Far-reaching social and political changes were giving promise of an enrichment and intensification of human possibilities and enjoyments. Bacon's age, furthermore, had witnessed the rise of new lines of investigation and of novel scientific methods, and these, in the persons of Leonardo da Vinci, Kepler, and Galileo—not to speak of their precursors and of Bacon's own contemporary countryman William Gilbert—had done much to dispel the mysteries of nature. To all these various influences Bacon was respon-

[8] *Novum Organum*, I, Aph. 129.

sive to a high degree. Temperamentally he was averse to the life of a cloistered scholar, and according to his reading of history it was through withdrawal from practical affairs that the ancients were led into barren speculations. Hence he was disposed both by inclination and by theoretical convictions to participate in the life of his day. Knowledge he would vitalize through connection with work-a-day experiences, through intimate relations to practice and empirical observation, through direction to humanly significant ends.

Giving full weight to all that may be claimed respecting Bacon's political and worldly ambitions, we are nevertheless warranted, upon a consideration of his life as a whole, in accepting his own profession that the progress of science was his deepest passion, and this because of the promise of science for human wellbeing.[9] Furthermore, he was convinced that truth is rightly "called the daughter of time, not of authority" and that our high regard for antiquity is misplaced for "the old age of the world is to be accounted the true antiquity; and this is the attribute of our own times.[10] Still again, the good life, for Bacon, consists in the pursuit of happiness for mankind as a whole in this our terrestrial habitation—that is, as he phrases it, "of power and dominion of the human race itself over the universe.[11] This pursuit, Bacon never doubted, could be crowned with success through the use of proper and discoverable methods and the willing co-operation of men. Here, then, we find elements involved in every significant ideal of progress. Because they found in

[9] *Cf.* the first chapter in Kuno Fischer's *Francis Bacon of Verulam,* translated by John Oxenford; also James Spedding's *The Letters and the Life of Francis Bacon,* vol. I, p. 4.

[10] *Novum Organum,* I, Aph. 84.

[11] *Ibid.,* I, Aph. 129.

Bacon an early representative, if not their first clear and vigorous spokesman, it is not strange that Bury begins with him, along with Bodin and Le Roy, his illuminating account of the origins of the idea of progress. To be sure, Bacon is represented by Bury as among the great precursors of the new era and not as one who really enunciated a theory of progress: Bacon's "conception of his own time as the old age of humanity," we are told, "excludes the conception of an indefinite advance in the future, which is essential if the theory is to have significance and value." To rest one's judgment at this point, however, would seem unjust. Bacon did indeed contend that he had discovered the key to the secrets of nature and that the future was in so far already captured. On the other hand, he repeatedly stressed the need for continuous research through systematic, co-operative effort carried on throughout the ages, and he held that thereby, though only thereby, there would come a steady improvement in the lot of man.

Bacon's progressist soul reacted with violence against the existing state of philosophy, as indeed against the doctrines of most of the earlier philosophers. In the case of his younger contemporary Descartes, it was primarily the confusions and the divergent teachings of the several philosophers that brought doubt and rejection. In the case of Bacon, however, the dissatisfaction was due partly, indeed, to the fact that the traditional philosophies were apparently unable to settle one question at a time so as to pass on to others and thus to build up a temple of truth, but partly—and primarily—to the fact that they were essentially barren. Their methods, their teleological preoccupations, and their conclusions were all such as to prevent them from playing an effective part in life and thus

of possessing practical value. Bacon therefore invites to his company all such as aspire "to overcome, not an adversary in argument, but nature in action; to seek, not pretty and probable conjectures, but certain and demonstrable knowledge."[12] He goes so far even as to insist that: "The logic now in use serves rather to fix and give stability to the errors which have their foundation in commonly received notions than to help the search after truth. So it does more harm than good."[13] Bacon, to be sure, did not entirely scorn inquiries into final causes. The difficulty, he avers, is that these have been misplaced; they have been assigned, as he puts it, to "the substance of sciences," and this "hath caused a deficience, or at least a great improficience, in the sciences themselves."[14] What the teleology of nature gives us, he holds, is a "confutation of atheism"; it enables us to conclude to the existence and to some of the attributes of God. Yet even here it must not be overlooked that Bacon thinks that even for the purposes of religion this knowledge is inadequate and must be supplemented by revelation. The main burden of his emphasis, however, is upon the fact that there can be no applied teleology; "the research into Final Causes," he writes, "like a virgin dedicated to God, is barren and produces nothing."[15]

The significant problems of theory, for Bacon, relate not to *why* things happen but to *how* they happen, not to final but to efficient causes. Inquiry into the latter affords results that divulge real connections in nature and therefore yield knowledge. Moreover, this knowledge is at the same time such as facilitates more satisfactory ad-

[12] *Ibid.*, Preface.
[13] *Ibid.*, I, Aph. 12.
[14] Quoted from Kuno Fischer, *op. cit.*, p. 93.
[15] Quoted from C. D. Broad, *The Philosophy of Francis Bacon*, p. 14.

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justments to the environment and more perfect control of its forces. Thus it contributes to the ethical goal dictated by the soul of Bacon and advanced in his ethical theory—namely, to "lay more firmly the foundations, and extend more widely the limits; of the power and greatness of man." Man's real power springs from knowledge. Moreover practical results are the solid justification of scientific research, indeed are the most reliable test of scientific truth.

Bacon's dictum, in his well-known aphorism, that "human knowledge and human power meet in one"[16] symbolizes the extent of his break with the past and concentrates the principle that flowered in the modern spirit. "Knowledge is power," said Bacon. And Bertrand Russell, like many another who has analyzed the structure of post-Baconian knowledge and the logic of modern science, has of late stressed the extent to which we may affirm that to know something is to be able to change it as we wish. Dewey, likewise, when concerned to interpret the procedure and the inmost meaning of those bodies of knowledge that today commend themselves to enlightened minds, affirms that knowing is a mode of experience which furnishes the "possibility of intelligent administration of the elements of doing and suffering." And so, he teaches, physical science must not set itself the aim, nor must it be thought of as serving the purpose, of disclosing the ultimate essence of things. What it does is to divulge those properties, that is those events, by virtue of which things become means to ends. This emphasis upon utility in discussions both of logic and of scientific methodology must not, however, in the case of Bacon any more than of Dewey, be construed as pragmatic in the very narrow

[16] *Novum Organum*, I, Aph. 3.

sense of this oft misunderstood term. In reference to a short-sighted pragmatic doctrine Bacon entered a vigorous protest. Writes he: "That unseasonable and puerile hurry to snatch by way of earnest at the first works which come within reach, I utterly condemn and reject, as an Atalanta's apple that hinders the race"[17] "Though it be true that I am principally in pursuit of works and the active department of the sciences, yet I wait for harvest-time, and do not attempt to mow the moss or to reap the green corn."[17] Be it noted, however, on the other hand, that Bacon sharply differed also from those who concern themselves with "the first principles of things and the highest generalities of nature," who "cease not from abstracting nature till they come to potential and uninformed matter, nor on the other hand from dissecting nature till they reach the atom." For these are "things which, even if true, can do but little for the welfare of mankind." "Utility and the means of working result entirely from things intermediate."[18]

Progress was for Bacon the ultimate objective. But progress, he insisted, comes "not from soil, not from climate, not from race, but from the arts"; "man is a god to man."[19] More especially is it invention that offers the one speedy and secure method to the attainment of progress. But invention must no longer be left to mere chance and the accumulations of lucky discoveries. Instead of the latter we must look to knowledge. But the knowledge which is capable of yielding inventions cannot be spun by reason from out its own innermost recesses, as is the wonderful but flimsy web from the spider. Fruitful knowl-

[17] *The Great Instauration,* Modern Student's Library volume on Bacon, p. 27.

[18] *Novum Organum,* I, Aph. 66, is the source of the quotations in the three immediately preceding sentences.

[19] *Ibid,* I, Aph. 129.

edge must have its footing in the facts to be understood and controlled. It must face existent realities free from all the veils that obscure them from our vision. We may master nature in practice only as we render her implicit obedience in the knowledge process. We need, therefore, rid ourselves of those predispositions and predilections, those idols, which distort our view. We must refrain from reading into nature our own desires and the pursuit of ends; we must be on our guard against any deflections arising from those experiences which are peculiar to ourselves as individuals; we must avoid the temptation of confusing words with things and the guiles of misleading theories and philosophical systems. In sum, the knowledge which Bacon desiderated reflects what Whitehead has called "a new mentality" such as William James characterized when, while finishing his *Principles of Psychology,* he wrote to his brother Henry James, "I have to forge every sentence in the teeth of irreducible and stubborn facts."[20] Partly because of his fear of the dangers that lurk in reason's proclivity to sheer speculation and to the deductive unreeling of conceptions, and partly because he lacked gifts in mathematics, Bacon was peculiarly blind to some of the essential features of the great scientific work that immediately antedated him. He failed adequately to realize the dependence of scientific method and of scientific conclusions upon mathematics. Hence he was prevented from either stating or working out "far-reaching physical theories himself."[21] Fearful that nature would not be permitted herself to dictate the connections of our ideas, he was suspicious of all tendencies of the mind to anticipate nature. Such anticipations, he believed, tended to lead to the selection of those facts alone which are con-

[20] *Cf.* A. N. Whitehead, *op. cit.,* p. 3.
[21] C. D. Broad, *op. cit.,* p. 62.

firmatory; indeed, they might even result in the straitjacketing of facts. In such moods and contexts, Bacon at times held that genuine knowledge comes primarily through an accumulation and analysis of facts. He then insisted that the understanding must not "be allowed to jump and fly from particulars to remote axioms"; it must not "be supplied with wings, but rather hung with weights, to keep it from leaping and flying."[22] This apparently overlooks the plain but important point that facts must function as stimuli to rationally developed hypotheses, through whose use alone observation may be significantly guided in such wise that principles acquire confirmation and that facts acquire the universal significance essential to every candidate for a knowledge that aspires to power.

In this matter, however, Bacon does not speak with a single voice. When not intimidated by the dangers of a barren or obfuscating rationalism and the temptations of thought to run amuck in the terrain of fact, he himself expressly recognized the indispensability of thought, as well as of empirical observation, in the acquisition of knowledge. Science may not emulate spiders, as we have already noticed; nor yet, as he teaches, may it like ants simply gather materials without selection and store them without modification. Rather must it bring rationalistic and empiristic procedure into fruitful union.[23] Like the bee, it must gather materials from nature, but then work them, through its own activities, into honey. Indeed, if order is to be introduced into the welter and confusion of fact, reason must, with proper precautions, proceed to or-

[22] *Novum Organum*, I, Aph. 104.

[23] "I suppose," writes Bacon, "that I have established forever a true and lawful marriage between the empirical and the rational faculty, the unkind and ill-starred divorce and separation of which has thrown into confusion all the affairs of the human family." *The Great Instauration*, Modern Student's Library, volume on Bacon, p. 15.

ganize its materials by reference to hypotheses: truth, said Bacon, "will sooner come out from error than from confusion."[24] "The true method of experience," he also wrote, "first lights the candle, and then by means of the candle shows the way; commencing as it does with experience duly ordered and digested, not bungling or erratic, and from it educing axioms, and from established axioms again new experiments."[25] Bacon declared that "a greater abundance of experiments" must be "sought for and procured, and that too of a different kind from those hitherto tried."[26] Furthermore, he rcegonized that the process of getting materials itself involves criticism and the use of instruments. The thermometer, for example, affords the corrective of thermal sensations, and the telescope and microscope are needed extensions of the range of unaided vision. Therefore he writes: "Neither the naked hand nor the understanding left to itself can effect much. It is by instruments and helps that the work is done, which are as much wanted for the understanding as for the hand. And as the instruments of the hand either give motion or guide it, so the instruments of the mind supply either suggestions for the understanding or cautions."[27]

Bacon was not himself a discoverer of new facts nor a frequent or competent experimenter. Fitting, however, it is to recall that it was in consequence of an experiment that he met his death.[28]

[24] *Novum Organum,* II, Aph. 20.

[25] *Ibid.,* I, Aph. 82. *Cf. The Great Instauration,* Modern Student's Library volume on Bacon, p. 15. "No excellence of wit, no repetition of chance experiments, can overcome such difficulties as these. Our steps must be guided by a clue, and the whole way from the very first perception of the senses must be laid out upon a sure plan."

[26] *Ibid.,* I, Aph. 100.

[27] *Ibid.,* I, Aph. 2.

[28] To test the hypothesis that flesh might be preserved in snow, he alighted from the coach in which he was riding, bought a hen from a peasant, and proceeded to make the experiment. He suffered a severe chill and this resulted in his death.

Quite apart, then, from the fact that Bacon set forth in detail necessary precautions in the use of the inductive method, and quite apart from his insistence that induction by simple enumeration must yield to the use of negative and prerogative instances[29]—so that Bacon anticipated Mill's joint method of agreement and difference, supplemented by his method of concomitant variations—Bacon must be credited with a doctrine of fruitful scientific procedure which is not wholly oblivious to the value of hypothesis and experimentation and thus also to the rôle of deduction.

To Bacon a correct logic and a proper scientific technique seemed of such paramount importance that he sometimes ventured to affirm that industry alone would be required to secure by their use an advancement in knowledge. Thus again, from this angle also, he must be accused of an inadequate estimate of the indispensable function of the creative understanding and the imagination in the promotion of science. His doctrine affords yet another evidence of his violent reaction against speculative constructions; it is testimony of his insistence that nature must scrupulously be followed as she tells her own story if we are to win that familiarity with her which will put us in possession of controlling leverages. It likewise, however, bears witness to Beacon's buoyant hope and firm confidence that progress is secure. Bacon was an unwavering optimist. His justification for this outlook, however, was not that of those of his predecessors who referred to guiding or indwelling divine or metaphysical powers. Bacon relied upon the fact that once and for all

[29] "For the induction . . . which proceeds by simple enumeration is a puerile thing; concludes at hazard; is always liable to be upset by contradictory instance; takes into account only what is known and ordinary; and leads to no result." *The Great Instauration,* Modern Student's Library volume on Bacon, p. 22.

there had eventually been gained the method of extracting from nature the secrets of her operations. This was for him also an achievement of great psychological import. For man must needs undertake new tasks; he must strive for progress through invention, and for invention through the advancement of science. But, believed Bacon, by far the greatest obstacle to such effort is the fact "that men despair and think things impossible."

As has variously been intimated, Bacon's success fell considerably short of his estimates thereof, and in some respects his doctrines failed even to express the best scientific procedure of his own day. Nevertheless, for heralding as he did the ideal and the possibilities of progress, and for giving logical expression to methods fitted to extend the frontiers of solid knowledge and to improve the lot of mankind, Bacon deserves the high place accorded to him in the history of man's struggles for the bigger and the better.

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PSYCHOLOGY AND PSYCHICAL RESEARCH

ONE of the first and most valuable of the lessons which Science has had to teach mankind has been *distrust* in the senses which so obviously appear to the ordinary man to be his only avenue to reality. To disillusion him on this point the sciences have laboured long and earnestly, and two stages have been required to effect it. At first, in antiquity, it had to be shown that the senses were deceptive and full of traps for the unwary. At this stage the ordinary man might be forgiven for thinking, as some philosophers still think, that scientific criticism of the deliverances of the senses was merely *sceptical:* but the subsequent history of the sciences has shown that it was merely *prudent.* For in modern times Science has gone on to show man that true knowledge is at bottom *power;* it now *protects* him against the defects of his senses, and equips him with a huge number and variety of instruments which enormously extend the scope, and increase the value, of the senses as means of knowing the real. Hence no one in his senses now thinks that the scientific criticism of sense-perception is sceptical in intention or effect.

But the work of science remains incomplete so long as we have not learned to test and scrutinize also the rest of our cognitive outfit, namely our desires, our emotions, and especially our so-called 'reason'. Now of these the two former are commonly recognized as dangerous and de-

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ceptive, but in the third our intellectuals have put far greater trust than either its achievements or its defects could warrant. Yet the whole history of philosophy may be read as an illustration of the deceptiveness of 'reason.'

Now the science to which the duty of teaching us properly to distrust our reason would naturally fall is Psychology: but Psychology, in spite of its importance and antiquity, is still in a very backward state. It has never been able either to discover a method of its own or to borrow an analogy from elsewhere that would really work and give it any effective *control* over the phenomena it studies. The result is that we have many psychologies—about a dozen at the moment—all different and all eager to offer (divergent) descriptions of mental life in technical and often highly ingenious terms, but no really *effective* Psychology that would enable us to control the mind and to remould it nearer to the heart's desire. Psychology as a whole therefore cannot yet be said to stand the pragmatic test, or to be a science in the fullest sense. It is still in the incipient stage of experimenting with assumptions which it may hope to turn into the principles on which a progressive science may be built. It is still engaged in selecting the 'facts' it is resolved to notice: it is still, in short, in that preliminary, but logically most interesting and instructive, phase of scientific development, in which everything as yet is plastic, with 'facts' still in dispute, 'principles' not yet settled, and with an abundance of alternative 'explanations.'

I

Now one of the methods of experimenting psychologically which we may adopt to explore this difficult but fascinating subject of Psychology is that known as Psychical Research. It differs from the ordinary psychologies

in its choice of the analogy which it adopts as its clue to the labyrinth of psychical facts. It has remained faithful to the original meaning of psychology as the science of the 'soul' whereas the academic psychologies have nearly all departed from it and become paradoxical 'psychologies without a soul.' They have allowed themselves to be fascinated either by the *prestige* of philosophy or by the success of the physical sciences. So they assumed that the nature of mind would be revealed either by philosophic argument or by faithful (not to say servile) imitation of the methods which had proved so effective in the physical sciences.

But both these anticipations have been falsified. Despite the obvious and undeniable connexion of the psychical with the physical, the analogy with the physical has proved sterile. The mind-body problem still defies solution—for it is no solution to abolish mind, on paper, to preserve a prejudice—and the transfer of 'exact' experimental methods from physics to psychology steadily refuses to yield results commensurate with the labour and ingenuity devoted to them. Now that physicists have realized that their 'laws' are only statistical averages, and are beginning to suspect that something remarkably like a psychological factor enters into the behaviour of their ultimate reals, it seems likely that enthusiasm for the physical as the master-key to everything psychical will be considerably abated.

The bankruptcy of philosophic psychology had been declared long before. Mental life therefore is still beyond control so far as academic psychology is concerned.

The clinical analogies and methods of the psycho-analysts, and psycho-therapeutists generally, for a while seemed more promising; but it is gradually growing clear that they too have found no Open Sesame. The success of their practice is insufficient to make up for the defects of their theories, which seem obscure, arbitrary, incoherent

and even absurd; and, even clinically, their methods are chancy and of doubtful efficacy.

II

The coast therefore seems to be clear for Psychical Research. Psychical researchers may rightly plead that their method is worth trying; and, if they ask to be taken up humbly, pertinaciously and prettily enough, they may now find the scientific world more open-minded than formerly and readier to explore what may prove to be as extensive a field of research as the physical. But they should make a clean breast of it.

They should admit at the outset that they are harking back to a very ancient stratum of beliefs, to a conception of 'soul' and its priority and power over the physical which underlies primitive 'animism' but has never been considered amenable to scientific method. Still it is worth remembering that the assumptions of commonsense realism are even more ancient than the notion of 'soul'; and admittedly neither science nor philosophy can dispense with them in practice.

Moreover these authorities have not been happy in their dealings with this very primitive notion of 'soul'. They have succeeded neither in explaining it nor in explaining it away. Neither as a 'substance', nor as a series of 'impressions and ideas', nor as a principle of 'synthetic apperception' have philosophers been able to account even for the *undisputed* functions of the 'soul'. The perversion of scientific method which leads to materialism or 'behaviorism' has no less conspicuously failed to *explain away* the soul: the pretence of its unreality is simply nonsense, and makes nonsense of all science. For what is science ultimately but an attempt to gratify our *desire* to know?

III

Psychical Research therefore is really more rational than philosophy and more scientific than science, in not pretending to know in advance of inquiry what 'soul', *alias* 'spirit', *alias* 'consciousness', *alias* 'self', is or can do. It is both scientific and practical in setting itself to find out *empirically,* by investigating the alleged evidence as to its doings.

This however is easier said than done. The difficulties in the way of effective Psychical Research are stupendous, and they will be overcome in the end only if they are recognized at the outset. The ordinary difficulties of inquiry which are common to the initial stages of a science are here enormously augmented. The scientific inquirer should everywhere start with a mind full of doubts and critical reserves about the adequacy and value of the hypotheses he uses as 'principles', for lack of any better. He should be prepared to encounter 'facts' which are no facts, or, even worse, are so infected with error and misapprehension as to be more misleading than pure illusions. He should expect also to find it difficult to experiment with any precision, nay even to experiment at all or to know what to observe. For he does not yet know whether his initial analysis of his subject is sufficiently relevant to start him on his way to truth, and cannot estimate on what conditions success and failure will depend. Nor has he sufficient *power* over the conditions to vary them at will and to select intelligently the important points he needs to inquire into further. Such power over his phenomena is the fruit only of a knowledge which *ex hypothesi* he has not yet acquired.

But these are the ordinary obstacles to the making of *any* science, and there is no reason to assume that intel-

ligent endeavour will not overcome them in Psychical Research as it has done elsewhere. What complicates the situation here is the number, complexity and intensity of *peculiar* sources of error which are largely of a psychological nature, and do not beset inquiry into matters that do not touch us so intimately. When a mathematician sets himself to work out the implications of a new conception, which is pretty sure to be an extension by analogy of an old one, he may be mildly (or even keenly) interested in the consequences; but he does not feel that his whole being is at stake and that his whole future depends on the success or failure of his hypothesis. But in Psychical Research the hypotheses in question are such that they can hardly fail to stir the most impassive soul, and to arouse intense emotional reactions. How can anyone be indifferent to the question whether the 'soul' is immortal, and whether he may look forward, or is doomed, to a life after death? This possibility must, it seems, produce an emotional bias, and render it desperately hard to conduct the inquiry *fairly,* and without vitiation by prejudice.

It would however be a mistake to assume that there was only *one* prejudice to guard against. Men *differ* in their reaction to this prospect. It is certainly not true that *all* desire a future life. A large number do *not* desire it, for various good and sufficient, but largely personal, reasons; and they are often influential persons. But they hardly ever *avow* their reasons, which therefore escape examination and criticism. This *hostile* bias is all the more insidious and dangerous because it works beneath the surface and in the dark—like moles and 'mediums'.

It may be true, no doubt, that the majority of men are desirous of believing in a future life and some kind of immortality for their 'soul'. The majority may even be a large one, *in a sense.* If, that is, all are counted into it

who *at any time* have felt the theory of immortality to be of spiritual importance to themselves. For this is an emotional condition which commonly attends the bereavements that afflict our mortal life.

But it does not follow that, at any given time, the majority share in, or approve of, this sentiment. On the contrary, in normal times the great majority are *strongly opposed* to any such 'unhealthy' interest in the future life, and there is severe social repression of those who proclaim its transcendent importance. Probably, in ultimate analysis, this opposition rests on nothing more respectable than the shrinking from the thought of *death,* which is implicit in any thought about immortality; but its strength is well brought out by the singular perversion which has overtaken the religious doctrines on this subject. In theory, the great religions are all ardent advocates of heavens or hells; but in fact they have all been watered down into a vague 'hope of immortality' which shrinks from testing, is quite ineffective, and can detract from no one's attention to business. The correctness of this estimate was curiously attested during the war, when the terrible prevalence of personal tragedies made the bereavement sentiment dominant for the time. The normal opposition to its manifestations was patriotically silenced, and there seemed to be a great wave of spiritualism threatening to deluge the high places even of the driest intellectualism. But a year or two later the social taboo was reimposed; I happened to be present when a representative of a great London daily called on the Secretary of the Society for Psychical Research to inquire whether the time had not come to do so, and was disappointed when no 'interview' was granted him.

The truth is, then, that the craving for immortality is highly seasonal, and that the 'belief' in immortality waxes and wanes with it. On the whole, taking mankind at large

and through the ages, it is a typical *'half-belief'*, for the analysis of which I may refer to my *Problems of Belief*, ch.V. But this does not make it *easier* to allow for, but harder, and complicates the problems of psychical investigation, because the scientific inquirer has to detect and discount so many sorts and shades of personal bias in every case he pries into.

As a consequence of this prevalence of bias, for and against, we may lay it down as an indispensable rule of investigation in Psychical Research that no statement on *either side* should be accepted on authority without stringent investigation; for such investigation will not infrequently show that perfectly respectable and otherwise credible witnesses have in this instance cheated and given false evidence—of course all from the highest motives!

VI

Next in importance to the perturbations due to bias come the obstacles in the way of research caused by deceptions, whether conscious fraud at the hands of others, or unconscious self-deception. The latter is so potent a factor that descriptions by a believer in psychical phenomena and by an unbeliever of the same events are often hardly identifiable as referring to the same affair. Both the frauds and the self-deceptions however are largely psychological, and they pass into each other, and play into each other's hands, in the most curious fashion. It is not too much to say that, of those who are deceived by trickery, three quarters are taken more than half the way by self-deception. Also what trickery there is would seem to depend more on exploitation of expectancy and lapses of attention than upon actual prestidigitation and the use of machinery, like ordinary conjuring.

It is this subtle co-operation of fraud and self-decep-

tion, rather than the mere prevalence of trickery, that creates the difficulties for psychical research in the *séance* room. For mere fraud is not impenetrable; it can be dealt with by the methods of the lawyer in handling a lying witness. But to cope with a witness who has had a genuine experience which he cannot understand, and then deceives himself in the interpretation and is ready to eke out his achievement fraudulently, needs psychological insight as well as legal acumen.

It would appear, however, to be an exaggeration to contend that no adequate safeguards against fraud can ever be devised. It is true no doubt that the absence of light in dark *séances* is *prima facie* a cloak for fraud and a very serious impediment to observation. It precludes ocular demonstrations, but after all other precautions may be taken, and progressively increased in stringency, until all conceivable possibilities of fraud are barred. Even now, in the more sensational exploits of the 'mediums' it is not so much the laxity of the conditions as the credibility and good faith of the witnesses that is impugned. Moreover the lack of control by the eye may be made good by a more extensive use of apparatus. It should not be difficult to set up machinery enough to obtain an automatic record of all that passes, physically, in the séance room, and even secretly to photograph all that happens, by invisible light. This would be simply a question of raising the money to build an adequately equipped psychical laboratory. Lastly it is not inconceivable that results may be attained which on the face of them proclaim their supernormal character, and could not have been achieved by normal means. The paraffin moulds of clenched hands obtained by several mediums, the pictures that formed themselves on the 'ectoplasm' exuding from 'Eva C', and now the fingerprints on dental wax produced by 'Walter'

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in the sittings of 'Margery' Crandon, would seem to be 'physical phenomena' which approximate *prima facie* to a fulfilment of this requirement. That few or none of the cases of 'subjective' phenomena seem to approach this standard seems to be mainly due to the difficulty of proving that a given bit of knowledge is truly supernormal and could not have entered a mind in a normal but forgotten manner. No doubt in a number of cases which at first were thought to satisfy this requirement, possibilities of trickery will subsequently be discovered; but this would only show that it is no more possible to exhaust the possibilities of fraudulent than of genuine knowledge, *a priori*, and that science can learn also from its failures. Decidedly, then, scientific research is well able to protect itself against fraud if it chooses, and if social approval provides the means for an investigation which may well be both prolonged and costly.

V

We may disallow also the somewhat dialectical objection, on which the editorial columns of *Nature* now seem to rely, that scientific investigation is impossible where, not the investigator, but the medium or the medium's control determines the conditions of experiment. For though this may be a suspicious circumstance justifying special caution, the value of an experiment does not in the end depend on who (or what) suggested it, but on its own character. Otherwise the theory of gravitation would have been discredited by the trivial accident of Newton's apple. If therefore an experiment was a good test and worked out well, the scientist should not allow his personal pique at not having been the first to devise it to vitiate his judgment.

On the other hand there are two formidable obstacles in the path of Psychical Research which have not yet been mentioned. The first is wholly practical and may be called the *lack of experimental control* over the phenomena inquired into. The second is theoretical and is composed of the philosophic difficulties of thinking out a world-order in which 'souls' and 'spirits' are effective entities that must be reckoned with. Certain considerations may however be adduced for holding that neither of the obstacles should prove insuperable.

Of course the psychical researcher's present lack of experimental control over his subject is an enormous practical drawback. It means not only that he cannot devise any decisive experiment but that he cannot summon up, multiply, and test the evidence at will, and according to requirements. He is reduced to the position of a dependent observer of whatever phenomena may chance to swim into his ken. He cannot try the sort of tests he requires nor direct his inquiry upon the doubtful and vital points. So he can do nothing to *ensure* the progress of his subject.

It follows that at present the logical status of Psychical Research is a weak one. It cannot stand the pragmatic test, on which in the end science always relies to overpower opposition. Even its best attested 'truths' remain probable and disputable, and it is a matter of taste and idiosyncrasy whether one believes them or not. This renders truth highly precarious in a subject where, as we have seen, many are tempted to disbelieve for reasons of their own.

But there is nothing in this situation as such which is *peculiar* to Psychical Research. All these difficulties beset any subject in which no experimental control has been attained. What renders the situation dangerous is the strength of the party hostile to the subject, and the fact that until experimental control is achieved the evidence in its

favour must remain *historical.* This again is not in itself a peculiarity, for there is a historical side to *all* scientific truth. Every such truth has been discovered and verified by a definite number of experiments or observations made by certain investigators at certain times. But where there is experimental control this body of evidence can be augmented at any time to any desired extent. Consequently the scientific truth becomes in a sense independent of the actual experiments which established it. Nor do the historical records which attest it lose credence with the lapse of time, because they can always be renewed by fresh experiments, even though these are not performed.

But in Psychical Research the evidence is continually being sapped and undermined by what seems the mere lapse of time. Evidence which was adequate at the time, and satisfactory and cogent to contemporaries, becomes vague, legendary, and incredible for later generations, which no longer know the witnesses and their character. Here the lapse of time, by turning first-hand attestation into documentary, is really nourishing a persistent doubt which has never been eradicated. For a really tenacious doubt can only be set at rest by a constant stream of corroborative evidence. Or, better still, by the pragmatic working of a truth in everyday life. It then soon ceases to be worth the sceptic's while to doubt the truths he sees in operation all around him.

At present, however, one must admit that Psychical Research has not yet overcome the weakness due to lack of experimental control, and must add that there does not seem to be any immediate likelihood that it will do so. Still one never knows.

VI

The second weakness of Psychical Research refers us back to the beginning of this article, in which it was pointed out that the belief in 'souls' was directly descended from primitive animism. It must now be emphasized that for primitive thought the notion of soul was by no means otiose and merely decorative. Souls were conceived, not as idly 'contemplating' the happenings in their bodies, but as highly *efficacious* agencies that inspired the course of nature. Modern science, however, appears to have wholly lost this conception of soul, and it may be suggested that it is precisely because it has done so that it has come to doubt the soul's real existence.

Yet this loss may have been a real loss to science. It has rendered incredible, not only the alleged impacts of the world of 'spirits' on our own and the bulk of the evidence for Psychical Research, but also a number of very attractive interpretations of the physical world, and particularly of the physiological processes of living organisms. For if we consent to entertain the thought that the soul may be an efficacious principle, it may be conceived as really animating and *moulding its body,* and we may proceed also to ascribe a psychic side to all material beings. That might render it more intelligible how even the electrons seem to *know* exactly where they are going, as they jump about from orbit to orbit within the 'atom'. And if we are willing to try the hypothesis that the soul may mould its body, we may cherish hopes of finding means of persuading it to *remould* us into something better. We have good reasons, then, for reconsidering the assumption that 'soul' must be an inefficacious, impotent 'epiphenomenon' that has no power over 'body'.

How did this dreary dogma ever come to prevail? The decisive reason seems to go back to Platonic metaphysics.

Plato was the inventor and champion of 'pure' spirit, and thought it necessary to protect its purity from all contact and contamination with the material. So he made the spiritual or 'Ideal' world constitutionally incapable of change or process, and degraded the physical, sensible world to 'mere appearance'. But science could make nothing of Plato's immutable patterns, and devoted itself to the study of the physical phenomena that 'pure spirit' did not deign to deal with. Naturally, however, as scientific methods prospered, what had begun as a modest disclaimer of topics too high for scientific treatment turned into an arrogant denial of the spiritual realities which claimed to transcend scientific treatment. So 'pure spirit' was taken at its word, and brutally told that if it would not *work,* neither should it be allowed the fun of 'contemplation', nor be supported at the expense of science. Since this support was withdrawn it has eked out a miserable existence and fed upon the thin abstractions of philosophy, till even its staunchest admirers may now be prepared to question the wisdom of separating it so utterly from the world of sensible reality.

If they show willingness to put their notions to the test of scientific working, shall Science reject their overtures? Assuredly it should *not,* and the marvellous alacrity with which scientists of late have been willing to scrap and remodel their most fundamental principles, from the conservation of energy down, augurs a favourable answer to a summons to enter upon the tantalizing field of exploration called Psychical Research.

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LOGIC AND LANGUAGE

ALTHOUGH Aristotle was not a pure formalist, he is rightly considered the father of the traditional logic. Many of the tendencies still found in logical analysis may be traced to his writings. It is interesting to note that his analysis of the proposition is linguistic. We only have to read his *De Interpretatione* to realize how strong the hold of linguistic analysis was upon him. For example, he defines the substantive in terms of the timeless,[1] because he finds no time indications in the Greek noun. Of course the Greek language has the word "widow," but apparently he never gave that term consideration. The word "widow" carries a time reference, since it indicates a woman who has had a husband but does not have one now. But Aristotle thought that all nouns were timeless and probably that accounts for his whole theory of timeless essences.

The traditional logician thought that the typical form of logical expression is to be found in the predicative sentence. This linguistic form is our clue to logic. The logician attempted to reduce all forms of expression to the predicative proposition. By the predicative proposition I mean a sentence in which the assertion is made by means of the verb "to be" used predicatively. Now it is interesting to note that the logicians gave this verb a timeless meaning, such a meaning as we have in the expression of

[1] *De Interpretatione*, 16[a] 19.

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mathematical truths. The propositional form was always assumed to take a meaning analogous to that found in the formula, "The triangle is a three-sided figure." Here the verb "to be" means "was, and is, and ever shall be, world without end, Amen." The formal logician thought that the predicative sentence was logic applied, yet he turns about and denies his theory by giving the predicative sentence a meaning in every case that is only applicable to a limited number of cases, for most of the predicative sentences have a definite time reference as is indicated by those sentences where the past and present are contrasted. Thus if I say, "The English are a civilized nation," that does not indicate they always have been. "But," it may be objected, "the term 'English' here means 'the English of the year of our Lord 1930.'" Well, if this meaning is given to the word, the time element is smuggled into the noun, and that seems to give a new meaning to the traditional logic. But even if time is handled in the noun aspect of the proposition, it does not explain the contrast found in such sentences as, "The English are a civilized nation, but before the advent of Roman civilization they were not." As a matter of fact, the traditional logic gives no proper place to the time element as it is embodied in language, and is really embodied in our thought.

I think that this example indicates that the traditional logic assumed that language, at least in predicative sentences, was logical, in its sense of the word, without a careful investigation into the meanings that language does actually have. Now I think that it would have to be acknowledged that from no point of view can any one of our historical languages be considered merely or completely logical. But there is much logic embedded within language and it represents certain achievements in logical

analysis. Moreover it has a high power of logical precision. Now the tendency of traditional logic has been to ignore this really logical aspect of language and to miss its subtle power of expression by giving arbitrary meanings to words. In this way artificial schemes can be built up, but they are false to the historic meanings of words. We have seen this already in the misuse of the verb "is" in the traditional logic, and all other formal logics so far as I know. This is likewise true of the adjective "some," and because of its misuse, as it seems to me, a whole vista of logical meanings have been hidden from the inspection of both modern and ancient formal logicians.

We are told by the logicians that "some men" in the statement, "some men are negroes" means "one, at least, possibly all men." But is that what the word does mean? In normal usage the sentence definitely excludes the meaning, "all men are negroes," and tells us specifically that only part of mankind is composed of negroes. De Morgan is right when he tells us in his *Formal Logic* that "some" usually means "part of" and tends to have the meaning "a small part."[2] This indicates how far the word is from meaning "possibly all." It has been argued time and time again that if we give "some" its normal meaning, "the traditional square of opposition would be destroyed." I think not; but I do think that sentences that we have been terming contradictories are not really contradictory at all. There are sentences that do fit into the traditional scheme, and for these sentences the scheme is valid. The two sentences: "At least some heavenly beings are angels," and "No heavenly beings are angels" are true contradictories; but the sentences: "Some heavenly beings are

[2] *Cf.* p. 58.

angels," and "No heavenly beings are angels" are not contradictory.

I suppose it is now clear that I am suggesting that we need to recognize more forms of subsumptive propositions than the traditional four. But most logicians seem to consider them enough—including most, if not all the members, of all the schools of logic. I do not think that the simple quantitative notion "part of" can be reduced to "part, possibly all" and "part not, possibly none" as Dr. Keynes does.[3] The notion "part of" is more simple and fundamental than the indefinite "part, possibly all." I contend that it needs a place in our logical system. Many of the present-day arguments against logic are really only arguments against its artificiality, and not against a more complete logic, and hence would fail if a logic richer in the necessary forms of expression should appear.

The traditional scheme of propositions deals with the quantitative aspects of the subjects of predicative sentences. There are many variations of the quantity of the predicate that are left unnoticed, and yet are exhibited in the language of literature and science. Sir William Hamilton suspected that this was true, but guided by the assumption that the predicate was always quantitative he lost the fruits of his insight. It was easily demonstrated that his conception of the meaning of the "A" proposition was false, and with this refutation it was thought that any expansion of the traditional group of four propositions must be false.

After studying Sir William's scheme I felt that there was germinal truth in his efforts to extend the number of propositional forms; but I felt that his principle was false, and that an empirical study of actual forms of usage was far superior to any such attempt as his, where

[3] *Cf.* his *Formal Logic*, p. 101.

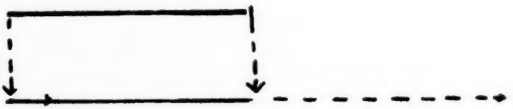
arbitrary methods were applied to actual linguistic usage. In other words, I searched for all possible examples of quantitative variations in both the subject and the predicate of the predicative sentences. After collecting these, I organized them, and searched for logical variations and principles involved. I found certain gaps in the scheme. Then I searched for examples that would cover, if possible, the deficiencies. After two years I have discovered the following forms exhibited in English usage. It may be that there are still other forms. I think that it would be rash to dogmatize as to other possibilities, since I recently discovered two forms that I thought did not appear in English; but it seems that only one or two more additional forms are probable.

In the diagrams I have used a modification of Leibniz's representation of the proposition. Euler's diagrams are unsuited to indicate all varieties of the quantities of the predicate, while Venn's and Carroll's diagrams indicate theories of the proposition that seem to me foreign to linguistic usage, at least as far as the "O" proposition is concerned.

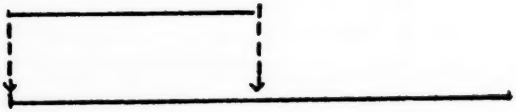
FORMS OF PREDICATIVE SENTENCES

UNIVERSAL AFFIRMATIVES

(A) *All Xs are Y.* (All angels are heavenly beings.)



(A_1) *All Xs are part of Y.* (All the Americans together are only part of the people of the world.)



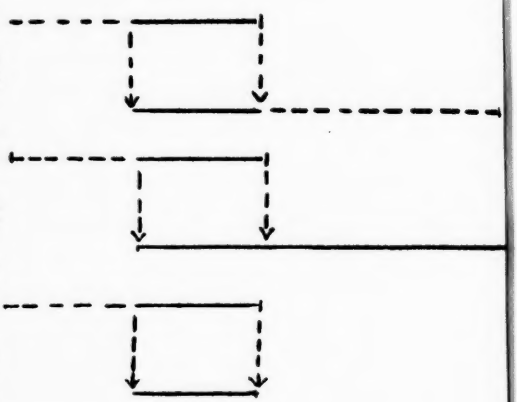
(A_2) *All X s are all Y.* (X=Y) (Equiangular triangles alone are equilateral triangles.)

INDETERMINATE AFFIRMATIVES

(I) *At least some Xs are Y.* (Some college students at least are educated.)

(I_1) *At least some Xs are part of Y.* (Some of us at least are among his friends.)

(I_2) *At least some Xs are all of Y.* (At least some of the forms of conifera make up all the vegetation of the island.)



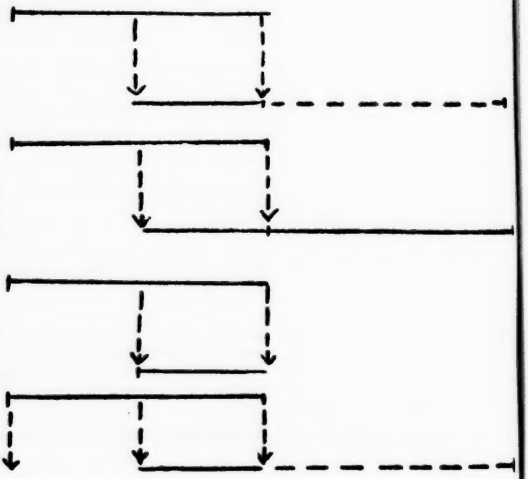
PARTICULARS

(I′) *Some Xs are Y.* (Some Americans are Anglo-Saxons.)

(I'_1) *Some X s are part of Y.* (Some of the forms of conifera are part of the vegetation of the island.)

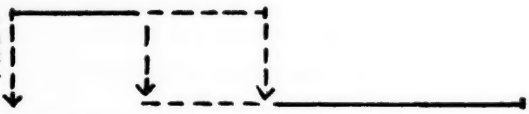
(I'_2) *Some Xs are all of Y.* (Some of my friends are all the friends he has.)

(O′) *Some Xs are not Y.* (Some eggs are not fresh.)



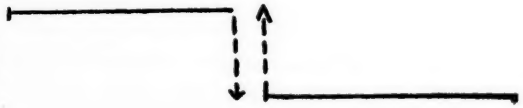
INDETERMINATE NEGATIVE

(O) *At least some Xs are not Y.* (Some South Sea Islanders at least are not educated.)



UNIVERSAL NEGATIVE

(E) *No Xs are Y.* (No Africans are Caucasians.)



It has often been said that an expansion of the propositional forms beyond the traditional four is of no advantage in inference. This is not strictly correct since it permits equational thinking, i. e., substitution of identities, as valid in formal non-mathematical reasoning. Also it allows the subject of the conclusion to be of definite quantity in three moods of the third figure, Datisi, Bocardo, and Ferison, and one mood of the first figure, Ferio.

Logicians have failed to realize the wealth of discrimination which our languages provide. We spoke above about the word "some." It is only one of the many words which may stand in a graded series between "all" and "none." Here are three such lists:[4]

I.		II.		III.
All		All		All
Many		Much		
A Few	(some)	A Little	(some)	Some
Few		Little		
None		None		None

Notice in I and II the delicacy of discrimination in indicating the amount of the proportional quantity. The word "some" is more indefinite than these words. Is

[4] *Cf.* Jesperson, *The Philosophy of Grammar*, p. 324.

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such definiteness illogical? And if logical, do not these words deserve a place in our logic, alongside of the more indefinite word "some"?

We have been inclined to think that the whole scheme of propositions should be very simple, and that the very simplicity of the thing was a proof of its truth. And yet a careful study of language seems to reveal a range of complexity in logical discriminations that exceeds anything of which we have dreamed. Let us examine one such phase of the logic which language has indicated, but which we have not yet noticed, as logicians. Suppose we examine the general list of quantitative terms,

All
Some
None

It is interesting to notice that if we negate either of the absolute terms, *All* or *None,* we get the meaning "some." "Not all" means "some," and "Nonulli" in Latin also means "some." English does not allow the negation of a negative in such cases. If the absolutes, "All" or "None," are negated the absolute aspect is destroyed, and the meaning "some" is produced. This is only a sample of the interesting developments of logic indicated by language itself.

Let me conclude with the exposition of a very ancient dilemma in accordance with Professor Jesperson's interpretation of it. Our logic books all give us that ancient sophism of Epimenides the Cretan, who says that all Cretans are liars. Thus he is himself a liar; hence his own statement is a lie, and Cretans are tellers of the truth, and even he is in his statement that all Cretans are liars. This dilemma is due to the logicians' false interpretation of language. There is no ambiguity in the term "liar"

as the exponents of the sophism assume. "Liar" does not mean an individual who always and without exception lies, any more than "preacher" means one who does nothing but preach, or a singer who only sings and never talks or whistles. Hence when a man is called a liar, it does not preclude the possibility of his occasionally telling the truth. It may even be that if a man is called a liar it is only implied that he sometimes lies. Thus the old dilemma was based upon a false use of language.[5]

[5] *Cf.* Jesperson, *Logic and Grammar*, p. 5.

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A NEW TREATMENT OF THE THEORY OF INFERENCE

1. Mathematical investigations about the infinite have led to antinomies the elimination of which requires a thorough revision of the fundamental principles of logic. Now since the main weapon in this fight against inconsistencies is clear reasoning, the process of logical inference has to be carefully analysed, and put into a convenient symbolic form, in order that every step may be revised as easily as possible.

Formal logic, in particular in the form worked out by Whitehead and Russell in their *Principia Mathematica*, is a general theory of statements, which has recently been presented in the first chapter of Hilbert and Ackermann's *Grundzüge der theoretischen Logik*. In this theory the particular content of statements is systematically ignored, only the truth or falsehood, the *truth-value* of statements being taken into account.

The leading ideas of this theory may be summarised as follows. A thing which is either true or false is said to be a statement. A third possibility is not excluded, but then the thing is not called a statement. Thus the theory in question is the theory of either-or.

A group of two statements A and B is not a statement until a convention is given assigning truth (T) or falsehood (F) to the group. We may agree, for example, that the group (A,B) is true only if both A and B are true; or that

(A,B) is true if either A or B is true. There are altogether 16 different ways of making (A,B) a statement and these are given in the following table where $\overset{+}{A}$ indicates that A is true and $\tilde{A}$ indicates that A is not true.

TABLE I.

Number of Convention	$\overset{+}{A}, \overset{+}{B}$	$\overset{+}{A}, \tilde{B}$	$\tilde{A}, \overset{+}{B}$	$\tilde{A}, \tilde{B}$	Symbols for the group-statements
(1)	T	T	T	T	
(2)	T	T	T	F	AB
(3)	T	T	F	T	A→B
(4)	T	F	T	T	B→A
(5)	F	T	T	T	
(6)	T	T	F	F	
...	...		...		
(12)	T	F	F	F	A+B
(13)	F	T	F	F	
(14)	F	F	T	F	
(15)	F	F	F	T	
(16)	F	F	F	F	

If we have a group of three statements these yield 8 instead of 4 different cases, and thus lead to $2^8 = 256$ different conventions for transforming the group into a statement. Similarly for higher groups.

The first and last conventions seem to be devoid of interest, leading to always-true and never-true statements. Curiously enough, however, in the formal construction of this logic these two kinds of statements play an important part not altogether different from that of ∞ and 0 in Mathematics. The chief object aimed at by Whitehead and Russell in their theory of mathematical sciences can be expressed by saying that they try to reconstruct fundamental mathematical ideas exclusively by means of always-true statements.

This general but rather empty theory of truth-values is further developed by adding to the truth-values fresh characteristics of statements referring necessarily to their content. The *Principia Mathematica* contains an exhaust-

tive formal analysis of existential and universal statements (there is an element belonging to the class a, every a is b).

It has not always been realised that as soon as we touch the content of statements we are dealing with particular classes of statements. Moreover, different kinds of relations between subject and predicate may require as many different symbolics. In science for example, and especially in mathematics, symbols and symbolic relations are grown out of the relations to be represented.

Everybody seems however to agree that the process of inference is carried out by confronting relations between classes or genera. Therefore I am putting forward in this paper *a theory of inference based exclusively on the properties of class-relations*. The chief object of the investigation is to clear the position for a thoroughgoing analysis of the principles involved. For this purpose I present the theory of inference as a special case of relations between statements about classes.

2. *Statements about classes.*

Two non-empty classes a and b are, with respect to one another, in one of the five mutually exclusive relations:

1/. Every element of a is an element of b and b has an element not belonging to a. This is represented by $a<b$.

2/. Every element of b is an element of a and a has an element not belonging to b: $a>b$.

3/. a and b have the same elements: $a=b$.

4/. a and b are mutually overlapping: $a \lesssim b$.

5/. a and b have no common element: a/b.

Formally we define classes as things having this property.

Our information however about the relation of the two classes a and b may not be complete. We may only know that a and b are not in the relation 3/., say. Or we may know that two definite cases are excluded, and so forth. The complete list of all possible types of information con-

tains $2^5 = 32$ cases, i.e. there are 32 different statements about the relation between two non-empty classes. If we denote exclusion by F (false), and "this is the case" by T we obtain the following table:

TABLE II.

	$a<b$	$a>b$	$a=b$	$a \gtrless b$	a/b	
(1)	F	F	F	F	F	either a or b is not a class.
(2)	T	F	F	F	F	$a<b$.
(3)	F	T	F	F	F	$a>b$.
(4)	F	F	T	F	F	$a=b$.
(5)	F	F	F	T	F	$a \gtrless b$.
(6)	F	F	F	F	T	a/b.
(7)	T	T	F	F	F	
...				...		
(25)	F	T	F	T	T	some a is not b.
...				...		
(27)	T	T	T	T	F	some a is b, some b is a.
(28)	T	T	T	F	T	
(29)	T	T	F	T	T	
(30)	T	F	T	T	T	
(31)	F	T	T	T	T	
(32)	T	T	T	T	T	both a and b are classes.

This table reads as follows. By convention (2) we mean that if the given a and b are in the relation $a<b$, the statement is true; and if a and b are in any of the other four relations, the statement is false, i.e. we state that $a<b$ and deny the other relations. By convention (7), we mean that the statement is true if either $a<b$ or $b<a$, and false in the other three cases. And so on.

Since the denial of existence is unavoidable in logic, the non-existence, i.e. the empty class, must be included among the possibilities. The introduction of the empty class gives rise to three new relations between two classes a and b: 1/. Both are non-existent; 2/. a is non-existent, b is existent; 3/. a is existent, b is non-existent.

For a complete survey of these eight relations we denote as usual by ab the common part of a and b, by $\bar{a}b$ or

$b\bar{a}$ the part of b that is not in a. Existence of any class a is denoted by $a > 0$ and non-existence by $a = 0$.

TABLE III.

(r_1)	$a\bar{b}=0.$	$ab=0.$	$\bar{a}b=0$	$a=0.\ \ b=0$
(r_2)	$a\bar{b}=0.$	$ab=0.$	$\bar{a}b>0$	$a=0.\ \ b>0$
(r_3)	$a\bar{b}=0.$	$ab>0.$	$\bar{a}b=0$	$a=b>0$
(r_4)	$a\bar{b}=0.$	$ab>0.$	$\bar{a}b>0$	$0<a<b$
(r_5)	$a\bar{b}>0.$	$ab=0.$	$\bar{a}b=0$	$a>0.\ \ b=0$
(r_6)	$a\bar{b}>0.$	$ab=0.$	$\bar{a}b>0$	$a/b.\ \ a>0,\ \ b>0$
(r_7)	$a\bar{b}>0.$	$ab>0.$	$\bar{a}b=0$	$0<b<a$
(r_8)	$a\bar{b}>0.$	$ab>0.$	$\bar{a}b>0$	$a \gtrless b$

Possessing some information about the relation between two classes a and b means the exclusion, for the given a,b, of one or several of the eight cases. If we know that seven are excluded, our information is complete provided we know that both a and b are classes. We know, in fact, which of the eight possible relations between a and b is actually realised in the case in question. Writing the eight relations in a row, we can, on the analogy of Table I assign T or F to everyone of them in $2^8 = 256$ different ways. Thus the logic of two classes, if it includes the empty class, contains 256 different statements. Denoting by 0 exclusion and by 1 admission of one of the relations in Table III, every statement can be symbolised by S (meaning statement) followed by eight spaces filled with 0 or 1. For example, S (0,0,0,0,0,1,0,1) means that both a and b are existent and that they are either distinct or mutually overlapping: a and b are either in the relation r_6 or in the relation r_8.

We notice however that exchanging a and b we only look at the same relation from the side of b. For example both r_2 and r_3 state that one of the two classes in question exists and the other does not. Similarly $a < b$ and $a > b$ state that one of the two classes is a part of the other. We

say that r_i is the *transposed of* r_k if we obtain r_i from r_k by exchanging a and b. The relations r_2 and r_3 and the relations r_7 and r_4 are the transposed of one another. The other four relations are identical with their transposed forms. Thus we obtain six essentially different relations and correspondingly $2^6=64$ different statements.

Three classes a, b, c determine seven parts $a\bar{b}c$, $a\bar{b}\bar{c}$, abc, $ab\bar{c}$, $\bar{a}bc$, $\bar{a}b\bar{c}$, $\bar{a}\bar{b}c$; the eighth, $\bar{a}\bar{b}\bar{c}$, being rejected as meaningless. Everyone of these distinct parts may be existent or non-existent. Thus the eight cases of Table III are replaced in this case by $2^7=128$ cases and information about the relation between three given classes a, b, c means that certain of these 128 cases are excluded. Therefore there are 2^{128} different statements about the relation between three classes.

Similar considerations apply to more than three classes. To simplify our problem we shall make use of the ordinary symbolics for classes.

3. *Algebra of classes.* The combination of two or more statements about classes can be dealt with by the general method given in Section 1. We shall replace this method however, by the direct combination of classes which enables us to attain to considerable formal simplifications. For this purpose we denote, as usual, by the "sum" a+b the united class, common elements taken only once; and by the "product" ab the class of common elements. The "obvious" properties of sum and product of classes are contained in the following list:

The laws of addition and multiplication of classes.

(1)	$a+b=b+a$	commutative law
(2)	$ab=ba$	
(3)	$a+(b+c)=(a+b)+c$	associative law
(4)	$a(bc)=(ab)c$	
(5)	$a(b+c)=ab+ac$	distributive law
(6)	$a+bc=(a+b)\,(a+c)$	
(7)	$a0=0$	product law

The laws of inequality (implication).
(8) $a+b+c\cdots>0$ implies that at least one of the classes a, b, c, $\cdots$ is not empty.
(9) $abc\cdots>0$ implies that $a>0$, $b>0$, $c>0$, $\cdots$
We notice that for every class, $a\geqq 0$ so that $a\leqq 0$ means $a=0$.
Law of substitution.
(10) If $a=b$, a and b can replace one another in every statement.

Negated classes.

For further simplification, and also to imitate the structure of ordinary sentences, we use the symbol $\bar{a}$ in the meaning "not in a" but only as a factor in a product containing a non-barred class-factor. This restriction is introduced in order to avoid the use of the principle of excluded middle. In this way we use negation only in the restricted sense: "not in a" and exclude the use of "non-a" as a class. Thus $a\bar{b}=\bar{b}a$ denotes the part of a which is not in b. If $b=0$, we put $a\bar{b}=a$. If $a=0$, we put $0\bar{b}=0$, so that the statement, $a\bar{b}=a$, or $b\bar{a}=b$, is fully equivalent to $ab=0$.

The rules for barred symbols are as follows.
(11) $(a\bar{b})c=a(\bar{b}c)=a\bar{b}c=\bar{b}ca$ commutative law
(12) $(a+b)\bar{c}=a\bar{c}+b\bar{c}$ distributive law
We notice that $a+\bar{b}$ has no meaning for us.
(13) $a<b$ implies $a\bar{c}\geqq b\bar{c}$
In certain cases equality is not introduced after multiplication. For instance when we multiply with the barred smaller term: $a<b$ leads to $0<b\bar{a}$ because, by hypothesis, b has an element not-in-a. The same holds when we multiply by $\bar{c}$ where $c\leqq a$. Finally
(14) $a\bar{a}=0$.

4. *Forms, equations and inequalities of classes.* A finite number of classes $a_1, a_2, \cdots, a_n$ given, the result of a finite number of additions, multiplications and barring of $a_1, a_2, \cdots, a_n$ is said to be a *form* $f(a_1, \cdots, a_n)$ in $a_1, \cdots, a_n$.

There are only eight different (not identical) forms in two classes a *and* b, *viz.* (1) a, b, $a+b$; $a\bar{a}=b\bar{b}=0$, ab, $\bar{a}b$, $a\bar{b}$, $\bar{a}b+a\bar{b}$.
$\bar{a}\bar{b}$ is not admitted.

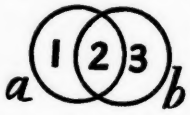
Proof. The linear forms are exhausted by the first three. The bilinear forms that do not figure in (1) are all identical to one of (1). E.g., $ab+\bar{a}b=b$, $a\bar{b}+\bar{a}b+b=a\bar{b}+b=a+b$, etc. Finally, multiplying any of the forms (1) by a, $\bar{a}$, b, or $\bar{b}$, we obtain in every term either a factor $a\bar{a}$ or $b\bar{b}$ reducing the term to 0, or a factor $aa=a$, $bb=b$ leading to the same term.

The seven non-zero forms of (1) correspond to the seven regions we can form by uniting any two or all the three of the regions $a\bar{b}$, ab, $\bar{a}b$ and the empty class.

For three classes we obtain in a similar way 128 different forms, and so forth.

An equation in a, b, i.e. two forms in a, b connected by the sign $=$, is said to be satisfied by one of the relations r_i of Table III when the statement expressed by the equation in question is true whenever a and b are in that relation. For example, $a+b=0$ is satisfied only by r_1; $\bar{a}b+a\bar{b}=0$ is satisfied only when a and b are in the relation r_1 or r_3; $a=ab$ is satisfied when a and b are in the relation r_1, or r_2, r_3, r_4.

The meaning of any logical equation in two classes is easily interpreted in terms of the three subclasses $a\bar{b}$, ab and $\bar{a}b$ denoted for our present purpose by 1, 2, 3. The letters i, j, k will denote any of the numbers 1, 2, 3, and when they occur in the same equation they are supposed to be different so that i, j, k is a permutation of 1, 2, 3.



In this symbolism the seven non-zero forms of (1), in a different order, are: 1, 2, 3, 1+2, 1+3, 2+3, 1+2+3. Equating any of them to 0, we state that one or two or all the three of 1, 2, 3 are 0. Equating any of the seven non-0 forms to any other we obtain 1/. equations $i=j$ or $i=j+k$ where the same number does not figure twice. 2/. Equations $i=i+j$, $i=i+j+k$ where one at least of the numbers 1, 2, 3 figures on both sides.

Equation $i=j$, e.g. $1=2$, is satisfied when both a and b are 0 and when $a=0$ and b is any class, i.e., $i=j$ is satisfied only by r_1 and r_2. The equation $i=j+k$ is satisfied only when $a=0$ and $b=0$, i.e. by r_1. Two existent classes cannot satisfy an equation of the first type.

The equation $i=i+j$ means that $j=0$, $i=i+j+k$ means that $j+k=0$, i.e. $j=0$ and $k=0$. An equation of the second type is a statement that one or two of 1, 2, 3 are empty, i.e., excludes four or six of the eight cases of II and is satisfied by the other relations.

Inequalities.

$i<0$ absurd, i.e. not satisfied by any class-relation

$i<j$ absurd unless $i=0$ when it states the existence of j

$i<j+k$ { if $i>0$, absurd; if $i=0$, states alternative existence for j, k: $j+k>0$
$i<i+j+k$ fully equivalent to $j+k>0$
$i+j<k$ { if $i=0$, $j=0$, states the existence of k: $k>0$; if i or j is >0, absurd
$i+j<i+k$ equivalent to $j<k$
$i+j<i+j+k$ equivalent to $k>0$
$i+j+k<0$ absurd for all the seven values of the right hand side
$i+j+k>0$ states alternative existence for 1, 2, 3.

To sum up, (i) an equation states that one or two or all the three of 1, 2, 3 are empty (ii) an inequality, if not absurd, states the existence of one of 1, 2, 3 or else the alternative existence of two or three of the subclasses 1, 2, 3.

5. *Consequences.* An equation or an inequality in a, b, as we have seen, states the non-existence of one or two or all the three of the sub-classes $a\bar{b}$, ab, $\bar{a}b$ or the existence of one or the alternative existence of two or all the three of the same sub-classes. Therefore *every statement about the relation between* a *and* b *can be expressed by alternative or simultaneous formulae* (equations and inequalities) *in* a *and* b. A relation is said to satisfy a system of alternative formulae if it satisfies one of the equations or inequalities of the system. Also in mathematics the two equations $ax+by+cz+d=0$ and $a^1x+b^1y+c^1z+d^1=0$ may be regarded as defining two planes or they may be regarded simultaneously as defining the common points of the two planes. In the general case a system of logical formulae contains both alternative and simultaneous groups of formulae. The solution of such a system in two classes means the determination of the relations $r_1, \cdots, r_8$ satisfying the system (or those not satisfying the system). In other words, to solve a system means to identify the system with one of the 256 statements or to show that the system is absurd. If all the solutions of a system S^1 are solutions of S, we say that S^1 is a *consequence* of S. They are *equivalent* if they have exactly the same solutions.

The word "implication" in Art. 3 can be interpreted as "consequence." For example the sentence: $a+b>0$ implies that either $a>0$ or $b>0$ (or both) means that the set of alternative formulae $a>0$, $b>0$ is a consequence of the formula $a+b>0$, i.e. when a and b are in the relation satisfying $a+b>0$, the same relation satisfies $a>0$ or $b>0$.

The same considerations apply when we have more than two classes. For the theory of inference in the usual sense of the word only the case of three classes is needed. A system of statements about a, b, c may have consequences not containing b. In syllogistic reasoning also the premises are specified statements, one about a and b and the other about b and c. A characteristic feature of the statements admitted in syllogistic reasoning is that they *exclude four of the relations* $r_1, \cdots, r_8$ *and admit the other four cases.* We shall call such statements *dichotomic.* There are $\binom{8}{4}=70$ dichotomic statements and six of them, viz.:

$a\bar{b}=0$, all a is b
$ab=0$. no a is b, no b is a
$\bar{a}b=0$, all b is a
$a\bar{b}>0$. some a is not b
$ab>0$, some a is b, some b is a
$\bar{a}b>0$, some b is not a

are expressed without alternative formulae. We shall call the last six statements *simple dichotomic.* Thus the *scope of the Aristotelian theory of inference* (*syllogistic reasoning*) *is the determination of simple dichotomic consequences in* a, c *of two statements* (premises) *one of which is a simple dichotomic statement in* a *and* b *and the other in* b *and* c.

Three classes a, b, c determine seven fundamental forms (2.1) and thus for three classes there are fourteen simple dichotomic statements, viz. any of the seven forms (2.1) equated to 0 or followed by >0.

6. *The Aristotelian theory of inference.* The first premise is one of the six statements $a\bar{b}\geqq 0$, $ab\geqq 0$, $\bar{a}b\geqq 0$. The

second premise is one of the six statements $b\bar{c} \geqq 0$, $bc \geqq 0$, $\bar{b}c \geqq 0$ and the conclusion is one of the six statements $a\bar{c} \geqq 0$, $ac \geqq 0$, $\bar{a}c \geqq 0$. We have inverted the usual order of the premises. There are 36 combinations for the two premises: 9 consisting of two equations 18 consisting of an equation and an inequality and 9 consisting of two inequalities.

We illustrate our method of obtaining the valid syllogistic moods by the example of Barbara: $a\bar{b} = 0$, $b\bar{c} = 0 \,|\, a\bar{c} = 0$. (In our symbols it is convenient to change the order of the two premises.) Among the seven fundamental forms of three classes only four are affected by the premises. It follows, namely, from $a\bar{b} = 0$ that $a\bar{b}c = 0$, $a\bar{b}\bar{c} = 0$. Similarly $abc = 0$, $\bar{a}bc = 0$. Thus four of the seven regions determined by three classes are empty. If two of them give one of the regions determined by a and c, viz. $a\bar{c}$, ac, or $\bar{a}c$, we conclude that this region is empty which is a dichotomic statement. For this purpose we have to join one of the two regions $a\bar{b}c$, $a\bar{b}\bar{c}$ to one of the two regions $ab\bar{c}$, $\bar{a}b\bar{c}$. In our case $a\bar{b}\bar{c} + abc = a\bar{c}$ and thus the conclusion is $a\bar{c} = 0$.

This is however not the only conclusion in which b does not figure. For example it follows from $a = ac + a\bar{c}$ that $a = ac$, but this is not a dichotomic conclusion. In the transposed (a and c exchanged) form of the mood called Bramantip we are asked to conclude that $ac > 0$ which would be a second dichotomic conclusion. The last step however supposes that $a > 0$, i.e involves a special, not dichotomic hypothesis. In ordinary logic it is usually understood that all the classes dealt with satisfy the condition in question, i.e. the empty class is excluded. Then, of course, $a\bar{b} = 0$, $b\bar{c} = 0 \,|\, ac > 0$ is a valid mood. For the time being we disregard these secondary moods.

Two inequalities as premises do not lead to any simple dichotomic conclusion. In fact taking $a\bar{b} > 0$, $b\bar{c} > 0$ for an

example, all we know of the seven constituent parts of $a+b+c$ is that *either* $a\bar{b}c$ *or* $a\bar{b}\bar{c}$ is >0 and that either $ab\bar{c}$ or $a\bar{b}\bar{c}$ is >0. Joining $a\bar{b}\bar{c}$ and $ab\bar{c}$ we obtain $a\bar{c}$ as before but according to the premises both of these parts may be 0 and thus we cannot conclude that $a\bar{c}>0$. The reasoning is general: from two alternative existences, existence for the sum does not follow necessarily.

Therefore we have to consider only 27 cases. However, the two reasonings $a\bar{b}=0$, $b\bar{c}=0 \mid a\bar{c}=0$ and $b\bar{a}=0$, $c\bar{b}=0 \mid \bar{a}c=0$ (a and c exchanged) are not really different since we aim at results valid for any pair of classes. Hence the reasoning must hold when both a and c are arbitrary classes. In particular, a may be c and c may be a. We shall say that the second mood is the *transposed* of the first so that transposition means exchanging a and c and changing the order of the premises (their order is irrelevant). This reduces the 9 cases in which both premises are equations to 6 and the 18 other cases to 9, viz.

1. $a\bar{b}=0$, $b\bar{c}=0$. 2. $a\bar{b}=0$, $bc=0$. 3. $a\bar{b}=0$, $\bar{b}c=0$.
4. $ab=0$, $b\bar{c}=0$. 5. $ab=0$, $bc=0$. 6. $\bar{a}b=0$, $b\bar{c}=0$.

and all the cases in which the first premise is an equation and the second an inequality.

We have dealt with case 1. Case 2 gives $a\bar{b}c=0$, $a\bar{b}\bar{c}=0$; $abc=0$, $\bar{a}bc=0$ and leads to $a\bar{b}c+abc=ac=0$ (Celarent). In the following four cases two of the four regions coincide and the other two do not lead to any of the three regions $a\bar{c}$, ac, $\bar{a}c$. Therefore they do not yield any dichotomic conclusion.

Now consider $a\bar{b}=0$, $b\bar{c}>0$. We have $a\bar{b}c=0$, $a\bar{b}\bar{c}=0$; $ab\bar{c}+\bar{a}b\bar{c}>0$. Since $ab\bar{c}$ may be 0 or may be >0, it is useless to unite it to $a\bar{b}\bar{c}$ in order to form $a\bar{c}$. We obtain a dichotomic conclusion only when a region of the first group coincides with a region of the second group so that the inequality reduces to a simple dichotomic statement. Then we complete the non-empty region to one of the

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three regions $a\bar{c}$, ac, $\bar{a}c$. We readily see that this condition is verified only in the following four cases:

$$\begin{array}{llll} a\bar{b}=0, & \bar{b}c>0 & \text{leading to} & \bar{a}c>0 \\ ab=0, & bc>0 & \text{leading to} & \bar{a}c>0 \\ \bar{a}b=0, & b\bar{c}>0 & \text{leading to} & a\bar{c}>0 \\ \bar{a}b=0, & bc>0 & \text{leading to} & ac>0 \end{array}$$

Formal proof of the first case. (i) if $a=0$, we have form $\bar{a}c=\bar{a}c+ac=c>0$, since by the second premise, $c>0$, (ii) if $a>0$, we have $\bar{b}c=a\bar{b}c+\bar{a}\bar{b}c>0$, by the second premise and the first term vanishes by the first premise so that $\bar{a}\bar{b}c>0$, i.e. $\bar{a}c>0$ by (3.9). Q.e.d.

Similar proofs for the other cases.

We collect the valid moods with their transposed moods in Table IV.

TABLE IV.

1.	$a\bar{b}=0$,	$b\bar{c}=0$	$a\bar{c}=0$	Barbara
2.	$a\bar{b}=0$,	$bc=0$	$ac=0$	Celarent, Cesare
3.	$a\bar{b}=0$,	$\bar{b}c>0$	$\bar{a}c>0$	
4.	$ab=0$,	$bc>0$	$\bar{a}c>0$	
5.	$\bar{a}b=0$,	$b\bar{c}>0$	$a\bar{c}>0$	Bocardo
6.	$\bar{a}b=0$,	$bc>0$	$ac>0$	Disamis, Dimaris
1a.	$\bar{a}b=0$,	$\bar{b}c=0$	$\bar{a}c=0$	
2a.	$ab=0$,	$\bar{b}c=0$	$ac=0$	Camestres, Camenes
3a.	$a\bar{b}>0$,	$\bar{b}c=0$	$a\bar{c}>0$	Baroco
4a.	$ab>0$,	$bc=0$	$a\bar{c}>0$	Ferio, Festino, Ferison, Fresison
5a.	$\bar{a}b>0$,	$b\bar{c}=0$	$\bar{a}c>0$	
6a.	$ab>0$,	$b\bar{c}=0$	$ac>0$	Darii, Datisi

Grammatically the relation $ab=0$ can be expressed in two fully equivalent ways: no a is b and no b is a. Similarly $ab>0$: some a is b and some b is a. Since these two grammatical sentences describe the *same logical relation*, there is no reason whatever to consider Ferie, Festino, Ferison and Fresison as different moods. ***All the four moods have the same logical relations between*** a, b ***and*** b, c ***for their premises and lead to the same logical relation between*** a ***and*** c.

Similar remark applies to Celarent and Cesare, Disamis and Dimaris, Camestres and Camenes, Darii and Datisi.

We also notice that some of the accepted moods are transposed of one another like Celarent and Camestres and some of the transposed moods are omitted (those of Barbara, Baroko, Bocardo and Ferio) because the conclusion cannot be formulated in the accepted sentence-form having a for its subject.

7. *Secondary syllogistic moods of Aristotelian logic.* We have in the preceding article accounted for 15 of the 19 accepted moods. In dealing with Barbara we have seen that the transposed Bramantip is valid only if $a>0$ or if we generally suppose that all the classes dealt with are existent. We obtain all the secondary moods in a similar way.

The conclusion of IV.1 yields $ac>0$ if $a>0$: that of IV.2 gives $a\bar{c}>0$ if $a>0$ and $\bar{a}c>0$ if $c>0$. If the premises contain an inequality, we change it into an equality by suppressing the bar or by barring either b or c and by supposing that b or c, as the case may be, is different from zero and thus we obtain the conclusion of the same mood. Thus $a\bar{b}=0$, $bc=0$ leads to IV.3 if we suppose that $b>0$, i.e. we obtain the mood: $a\bar{b}=0\ bc=0|\bar{a}c>0$.

In the case of IV.4, $b\bar{c}=0$ leads to
III.4 if $b>0$ and $\bar{b}c=0$ leads to IV.4 if $c>0$. Similarly III.5 yields
$a\bar{b}=0$, $bc=0|a\bar{c}>0$ if $b>0$ and IV.6 yields
$\bar{a}b=0$, $b\bar{c}=0|ac>0$ if $b>0$, and
$\bar{a}b=0$, $\bar{b}c=0|ac>0$ if $c>0$.

Similarly for the transposed moods. Thus we obtain the table of secondary moods with their transposed forms:

TABLE IV.A

7.	$a\bar{b}=0$, $b\bar{c}=0\|ac>0$ if $a>0$	weakened Barbara
8.	$a\bar{b}=0$, $bc=0\|a\bar{c}>0$ if $a>0$	weakened Celarent
9.	$a\bar{b}=0$, $bc=0\|\bar{a}c>0$ if $c>0$	
10.	$ab=0$, $b\bar{c}=0\|\bar{a}c>0$ if $b>0$	
11.	$\bar{a}b=0$, $b\bar{c}=0\|ac>0$ if $b>0$	Darapti

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7a.	$\bar{a}b=0,\ \bar{b}c=0$	$ac>0$ if $c>0$	Bramantip
8a.	$ab=0,\ \bar{b}c=0$	$\bar{a}c>0$ if $c>0$	
9a.	$ab=0,\ \bar{b}c=0$	$a\bar{c}>0$ if $a>0$	weakened Camestres or Camenes
10a.	$\bar{a}b=0,\ bc=0$	$a\bar{c}>0$ if $b>0$	Felapton, Fesapo
11a.	$\bar{a}b=0,\ b\bar{c}=0$	$ac>0$ if $b>0$	Darapti

In traditional logic, moods containing $\bar{a}$ in their conclusion have been ignored since a cannot be the subject of the conclusion if we keep to the four accepted forms of sentence. Thus Table IV gives eight logically different moods and Table IVa gives six logically different moods (since Darapti is its own transposed). From the latter six moods the three weakened moods are usually disconsidered. Therefore, for non-empty classes, we obtain eleven not weakened moods with a as the subject in the conclusion. If we add the eight moods which differ only grammatically from other moods, we obtain the 19 moods of scholastic logic.

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P. DIENES.

NOTES AND NEWS

By a gift of the late Edgar Pierce, Ph. D. Harvard 1895, and author of "The Philosophy of Character," a Lectureship in honor of William James has been established in Harvard University. Dr. Pierce was at one time Instructor in Psychology at Harvard and later a member of the Visiting Committee for the Department of Philosophy and Psychology. Appointments to this Lectureship will be made at least biennially, the appointees being in residence at the University and participating in the regular instruction. Professor John Dewey will be the first lecturer on this foundation. During the spring term beginning February 1931, he will deliver a series of ten public addresses on a topic not yet announced. The subjects covered in the William James Lectures are not limited in any way, beyond the general condition that they must fall within the field of philosophy and psychology. The lectures will appear in book form.

The Seventh International Congress of Philosophy will meet, September 1st to 5th, 1930, at Oxford, England. The programme of the Congress will be as follows:—

A.—GENERAL PLAN.

Monday Evening, September 1st—
Opening Meeting. Addresses of welcome, and reply by Representative of Foreign Delegates.

Tuesday, Wednesday, Thursday and Friday, September 2nd to 5th—
Mornings, 9:30—12:30.
Simultaneous Section Meetings in all Four Divisions.
Tuesday Afternoon.
General Session. Division A.
Wednesday Afternoon.
General Session. Division B.
Thursday Afternoon.
General Session. Division C.
Thursday Evening.
Business meeting.
Friday Afternoon.
General Session. Division D.

B.—SESSIONS.

Division A - - Metaphysics—General Session.
Subject: Are recent advances in physics of metaphysical importance?
Section 1.
Subject: Is a philosophy of history consistent with the facts of history?
Section 2.
Subject: Must biological processes be either purposive or mechanistic?
Section 3.
Subject: The relations between Metaphysics and Religion.
Section 4.
Subject: Open Session.

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B.—SESSIONS—Continued.

Division B - - Logic and Epistemology—General Session.

Subjects: (a) The value of recent contributions to Logic.
(b) Phenomenology.

Section 1.
Subject: The nature of perception and of its objects.

Section 2.
Subject: The nature and source of non-perceptual factors in thinking.

Section 3.
Subject: The relation of scientific thinking to the ideal of knowledge.

Section 4.
Subject: Open Session.

Division C - - Ethics, Politics and Aesthetics—General Session.

Subject: The value of Ethical and Political Philosophy as guides in practice.

Section 1.
Subject: Is the distinction between moral rightness and wrongness ultimate?

Section 2.
Subject: Is the ground of political obligation always one and the same?

Section 3.
Subject: Recent suggestions in the theory of Fine Art.

Section 4.
Subject: Open Session.

Division D - - History of Philosophy—General Session.

Subject: In what respects has Philosophy progressed?

Section 1. Subsection (a) Ancient Philosophy.
Subject: What is alive and what is dead in the Philosophy of Classical Antiquity?

Subjection (a) Mediæval Philosophy.
Subject: The philosophical problems at issue in the XIIIth and XIVth Centuries.

Subsection (c) Oriental Philosophy.
Subject: What contributions have been made to Philosophy by Eastern Philosophers (including Jews and Western Arabs)?

Section 2. Philosophy of the XVIIth and XVIIIth Centuries.
Subject: Has Kant by the introduction of his transcendental method rendered the study of his predecessors unnecessary?

Section 3. Philosophy of the XIXth and XXth Centuries.
Subject: Open Session.

SOME RECENT BOOKS

The Theory of Morals: An Introduction to Ethical Philosophy. By E. F. CARRITT. Oxford University Press, 1928. Pp. xii+144.

With a clarity that triumphs over severe brevity and closely reasoned argument, the present exposition develops the author's conclusions through the method of stating and criticising the more important ethical theories in their natural, as contrasted with their historical, order. It begins, that is to say, with the crudest theory and shows how this fails to satisfy; this then is replaced by another, which itself in turn suffers the same fate. Thus we are carried progressively from the doctrines of hedonism to those of evolutionary ethics, utilitarianism, perfectionism, self-sacrifice and self-realization, and the common good. Central to the conclusions finally reached are the following theses: "If we do what we think wrong or fail to do what we think right we act *immorally*, and the *guilt* is in proportion to our clear consciousness of stringency in the obligation. If we do the act that we think right, and do it for that reason simply, we act *morally*, and the *merit* is in proportion to the strength of the desires resisted. Moral and immoral acts are spontaneous acts of choice: they are free in the fullest sense. If, however, we do the act that we think right simply because we desire to do it (apart from thinking it right) more than we desire not to do it or to do anything inconsistent with doing it, I should not call the act moral. When the desire that we act upon is of a kind that usually leads to right acts, and therefore ought to be encouraged, I call it a *virtuous* act. When, on the other hand, the desire is of a kind that usually leads to wrong acts, and therefore ought to be discouraged, I call it, for lack of a proper name, a *vicious* act."

Personality and Immortality in Post-Kantian Thought. By Ernest G. Braham. London, George Allen & Unwin, Ltd., 1926. Pp. 246. 7s.6d.

The first part of this volume is a more or less sketchy and disjointed account and critique of the views of McTaggart, Bradley, Bosanquet, Lotze, James and Ward; the second, concludes from an independent analysis that the self is "a unified system possessing reality, that it dominates the body, that it increases in independence in its evolution, and finally may be capable of existing apart from the body." That the self does so exist is argued on the ground that (a) the persistence of personal life is necessary if moral values are to be conserved and justice is to be vindicated; (b) man's moral life of the here and now remains incomplete, and the most reasonable interpretation is that the insistant endeavor to realize the good points to the fact of immortality; (c) immortality is bound up with a theistic philosophy as expressed in the doctrine of God as Love—indeed, "as soon as we are brave enough to accept the revelation of God the belief in personal immortality is secure." As a whole, the study, which is part of a doctorial dissertation, scarcely exhibits an independent grasp of the philosophies it expounds or a realization of the profounder problems connected with the interpretation of personality in its bearing upon the question of immortality.

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Methods of Private Religious Living. By Henry Nelson Wieman. New York, The Macmillan Co., 1928. Pp. 218. $1.75.

Forged in the fire of his own experimental living, as the author declares them to have been, and tested by the processes of sober reflection, the methods of worship and of securing the power and joy of religious life here set forth should be of great value to all who seek a fuller integration of personality in harmony with the social world and the wider cosmos. Manifest within the cosmos are potent tendencies toward progressive integrations, and the battle front has reached the frontiers of those associations called human society. "Religion of the noblest kind is man's recognition of this creative cosmic struggle and his personal allegiance to the process of progressive integration. Therefore the religious man must be disciplined and equipped in body and mind so that he will have more energy for achievement than any other of like constitution and opportunity who has not the resources of religion; he must have more calmness and mastery in the midst of peril, age and turmoil; better physical health because of the poise and regimen of his life; more sensitivity and deeper insight into the bonds of interdependence which hold men together into a great community which exceeds the reach of their mutual understanding and cooperation; a more passionate and richly integrating life purpose which can transmute and glorify the common things of daily experience; a capacity for joy which absorbs the goods and beauties of the world without making him selfish and unprogressive; a mystic method for achieving insight in the midst of the most complex and baffling problems of life. . . . If a man knows how to practice his religion as he should, it will provide him with this equipment of personality."

A Philosophy of Ideals. By Edgar Sheffield Brightman. New York, Henry Holt & Co., 1928. Pp. vi + 243.

Idealism, for the writer of this volume, is a philosophy of ideals. It comprises not merely the view that ideals are potent human instrumentalities but likewise the doctrine that they are a revelation of the cosmos, that they are embodied alike in experience and nature. This philosophy the author differentiates from its major rivals of today and defends, more specifically in the form of personalism, against various lines of attack. He conceives values to consist "in a society of persons, attaining common purposes, and realizing common ideals; such that these purposes and ideals find their significance in being the expression and fulfillment of persons and what they ought to be."

New Horizons of the Christian Faith. By Frederick C. Grant. Milwaukee, Morehouse Publishing Co., 1928. Pp. xxix + 297. $1.50.

In this volume, presenting the Hale Lectures for 1927-28, the newly elected President of the Western Theological Seminary, aims to further the elaboration of a comprehensive synthesis of thought, faith, and ethical and aesthetic experiences. "For in fact it is little less than a Christian philosophy that we require, a philosophy of life, of the world, of destiny, of the spiritual significance of the universe: a central position which shall dominate all our thinking and give order to the whole of experience, thought, and feeling." Erudition, earnestness and thoughtfulness characterize the undertaking, and its results should prove of value to serious students of religion and theology.

Kant's Inaugural Dissertation. Translated by John Handyside. Chicago, The Open Court Publishing Company, 1929. Pp. xii + 85. $2.00.

These admirable translations of selected passages from the very first published treatise (1747) of Kant, *Thoughts on the True Estimation of Living Forces*, of his essay, *On the First Ground of the Distinction of Regions in Space*, and of his *Dissertation on the Form and Principles of the Sensible and Intelligible World*, together with the brief introductory note by the translator of the last two essays, the late Mr. John Handyside, and the preface by the translator of the selections and the editor of the volume, Professor Norman Kemp Smith, constitute an important contribution to philosophical literature in the English language.

The Misbehaviorists. By Harvey Wickham. New York, Lincoln MacVeagh (The Dial Press), 1928. 294. $3.50.

The author makes a somewhat witty and satirical attack on many of the contemporary thinkers. In the opening chapter he discusses "the modern temper" and contends that the "old" is better than the "new." He then criticizes various modern thinkers such as Watson, McDougall, Freud, Wiggam, Dorsey and others, including Will Durant, whom he calls "the Misbehaviorists." He discusses chiefly the contradictions and other apparent weak points in the books of these men, but his selection of quotations for attack covers such a wide period of time that it is doubtful whether his attacks upon closer inspection are not rather weak. He includes Will Durant among the misbehaviorists for not giving the scholastics and particularly Thomas Aquinas sufficient treatment. It appears here that the author is a partisan of the scholastic tradition. In his final chapter he shows that the modern temper is in reality very ancient. "Certainly the temper of these gentlemen is no newer than is the temperament of Lucifer." Perhaps a number of the "modern thinkers" would not consider themselves in bad company.

The Meaning of Selfhood and Faith in Immortality. By Eugene William Lyman. Cambridge, Harvard University Press, 1928. Pp. 47. $1.00.

This booklet, presenting The Ingersoll Lecture for 1928, approaches the problem of immortality not as an isolated issue to be settled by an abstract course of argument, but as a question vitally connected with general theories of mind and of reality, of the meaning of life and the nature of our universe. In opposition to the contemporary naturalisms which identify the human self with the physical organism (the author refers to J. B. Watson) or which teach the inseparability of the two (as do S. Alexander and R. W. Sellars), Prof. Lyman portrays the self as "a center of creative experience, as the decisive factor in social evolution, and as gaining truth and power through uniting itself with the substance of the universe." Such a self *may*, he argues, be perpetuated, and faith becomes justified in holding that it actually is an heir of immortality when it takes into consideration the grounds for a theistic metaphysics, namely, "the order and organization which appear throughout the universe, the extent to which the universe has proven to be a producer of progress, and the fulfilment of selfhood which comes through interpreting human individuality as an integral part of a cosmic process which is creative of harmony."

Philosophy of Value. An Essay in Constructive Criticism. By Leo Richard Ward. New York, The Macmillan Company, 1930. Pp. x + 263. $2.25.

The problem of value has figured prominently in recent philosophical literature, but until the appearance of the present volume nothing of a comprehensive nature on this subject has been available in English from the Catholic and Thomistic standpoint. A critique of prevailing views and, more especially, an analysis of why we act at all and of the "common-sense datum of value" leads the author to the conclusion that value is the capacity of an existent to be an end of action. Value, he holds, is not really separable from the object but "is in the object and not in the relation, not in the action, the need or the agent." Expressed otherwise, the thesis is that "wherever there is action, there certainly is value; indeed, at such place, value is demonstrated. But unmistakably, there is static value in the mere existent from the beginning, because the existent is possible aim of action. Yet functional value needs something in addition to *ens* or existent and in addition to this as desirable; to *ens* as desirable, functional value adds the element of being desired. This makes a logical difference. Such a view of course puts value very nearly into the category of 'good' or *bonum*. For value, we say, is resident within the existent always, and is functionally there when this is object or is sought. And 'good' says Saint Thomas, 'is anything'—is the thing itself—'in so far as it *can* be *striven* for and in so far as it *is the end of conative* action.'"

An extensive annotated bibliography adds to the usefulness of the volume.

The Alchemy of Light and Color. By Oliver L. Reiser. New York, W. W. Norton & Company, Inc., 1928. Pp. 78. $1.00.

The New Science Series is again enriched by a thoughtful booklet. In this case we are told of the physical, chemical, biochemical, and neural bases of color, in terms of recent scientific discovery and conjecture. Summarizing his results, Prof. Reiser states that he has sought to exhibit the mutual implications of the following ideas: "(1) The oxidation and reduction of carbon compounds underlie the production of color in chemical substances; (2) the chemistry of life is the chemistry of carbon compounds; (3) the doctrine of chronaxy supplies a suitable substitute for the specific energies theory; (4) that by associating the frequency of neurone discharge with the attendant electro-magnetic fields of force (of which "bioluminescence" in vision is but a special case) we have provided a basis for the qualities of conscious experience the presence of which the behaviorist cannot explain by his system; (5) that consciousness of color therefore somehow reduplicates the physical conditions of color; (6) because secondary qualities inhere in physical reality." Mind is conceived as "the expression of the dynamic equilibrium of labile tensions in the energy-fields"; the soul is described as "the harmony of the body."

Matter, Life and Value. By C. E. M. Joad. London, Oxford University Press: Humphrey Milford, 1929. Pp. xviii+416.

In this comprehensive volume, the author elaborates views set forth in his smaller works and particularly in the essay "A Realist Philosophy of Life" which he contributed to *Contemporary British Philosophy* (Second Series). In a somewhat original manner and in commendably intelligible terms he brings together a realistic epistemology with a vitalistic metaphysics.

Following a critique of materialism and mechanism, the concept of life is set up as an independent principle. The conclusion reached, however, is not a monism but a pluralism argued on the basis of the nature of relations. Knowledge, it is urged, is by perception, which is the awareness of sense data, and by thought, which is the awareness of subsistent objects. The exposition of this particular thesis shows Mr. Joad at his best; in fact, it presents an exceptionally persuasive account of one particular type of a realistic theory of knowledge. Values in the realms both of ethics and of aesthetics are held to be objective in the sense of being independent of the fact that they are known. Similar to Platonic ideas, they are described as transcendental to the world of sense.

The Philosophy of Art. By C. J. Ducasse. New York, Lincoln Mac Veagh, The Dial Press, 1929. Pp. xiv + 314. $3.50.

According to its author, "the present volume is the first of a projected group, the aim of which will be to develop in the principal fields of philosophy a certain point of view," one that endeavors "to push relativistic analysis as far as it will go in all fields of philosophy." It is by use of this method that Professor Ducasse develops his theory of art. Its characteristic theses are said to be: "that art is the language of feelings; that the range of human feelings includes vastly more than the few emotional states for which we have names; that language is essentially objectification, and only secondarily communication; that art and beauty are things essentially distinct...; that Beautiful and Ugly are terms predicating of objects only the fact that some one who contemplates them aesthetically obtains from them feelings that are pleasant, or unpleasant; that judgments of beauty are therefore wholly relative to the constitution of the individual observer, and are 'valid' for others only as far as those others happen to be constituted like him; that art-critics are therefore never at all 'authorities' in matters of beauty and ugliness, but at best only guides, who may direct our attention to things which we then sometimes find beautiful and might otherwise have overlooked."

The Quest for Certainty: A Study of the Relations of Knowledge and Action. By JOHN DEWEY. New York, Minton, Balch and Company, 1929. Pp. 318. $4.00.

In this, the most recent and, in many ways, the clearest, statement of his doctrine, Professor Dewey essays to show: (1) that philosophy's present failure directly to function in life is due to the historic separation of "thinking" from "doing"; (2) that this separation of thinking from doing springs from causes which antedate the rise of modern science and the present overwhelming interest in the "here" and the "now"; (3) that modern scientific method (wherein, incidentally, our most effective thinking is declared to take placee) has completely abandoned the older notion of thinking as a "beholding of fixed and antecedent existences" in favor of a conception of thinking as a kind of "experimental operation," in which the "object of *knowledge* is prospective and eventual, being the result of inferential or reflective operations which redispose what was antecedently existent"; or, that "the true object of knowledge resides in the consequences of directed action"; and, finally (4) that, until this "Copernican revolution" becomes effective generally, philosophy must remain an inadvertence, an alien intruder upon the present scene, and can have no active part "in the drama of an onmoving world." The book concludes with a prophetic note in which its author indicates certain changes, both theoretical and practical, that could reasonably be expected to follow were philosophy to be conceived as method and divorced from all traffic with the "occult" and the "transcendental."

This volume contains no new doctrines. It does, however, give a touch of freshness and a new direction to old ones. For the first time Dewey here makes full use of the implications of scientific method in support of his instrumentalism. He even proposes to substitute Professor Bridgman's term "operational thinking" for that of "pragmatism." Furthermore there is noticeable a shift in the direction of realism. While this shift is as yet not explicitly avowed, and while the author's insistence upon the reconstructive and operational character of thought shows no decline in vigor, the ghost of realism more and more haunts the background of Dewey's instrumentalism.

Phenomenology as a Method and as a Philosophical Discipline. By Marvin Farber. Buffalo, University of Buffalo Studies, Vol. VI. Pp. viii + 130.

The author describes his purpose as twofold: first, "the presentation of phenomenology as a method and as a philosophical discipline, in the sense of Husserl, and with some regard to the history of concepts introduced;" secondly, the "systematic orientation and consideration of some of the really fundamental problems of philosophy, the last questions of knowledge." Prof. Farber has rendered a distinct service in directing the attention of English-speaking readers to an important philosophical movement which they have as yet too much neglected, and for aiding those who have wrestled with the obscurities of Husserl's own writings to a clearer understanding of this thinker's central ideas. The monograph leaves one with the impression that phenomenology is a fruitful field needful of further cultivation.

What Philosophy Is. By Harold A. Larrabee. New York. Macy-Masius, 1928. Pp. xii + 204. $2.00.

Those who require an introduction in preparation for the facing of some one of the many introductions to, or first books in, philosophy, or who desire a book which he who runs may read, and that with some degree of interest, will find what they seek in Mr. Larrabee's elementary sketch of the spirit, motivations, quest, methods and divergent doctrines of philosophy. The book will not carry a reader far but during the journey it will insure him ease and enjoyment; it provides no stirring insights but perhaps it suggests that philosophy and philosophers have revelations in store for those who will gird their loins for the arduous ascent to the heights where these revelations become possible.

UMI

A Study in the Logic of Value. By MARY EVELYN CLARKE. University of London Press, Ltd., 1929. Pp. x+330.

Recent discussions of the theory of value have yielded a rich literature. The contribution before us deserves study partly for the rigorous way in which it deals with psychologistic tendencies, though mainly for its classification of the various theories of value and its spirited defense of the view that value is "a unique determination of objects, apprehended through judgment, but subsisting, like any other predicate, independently of the judging subject." The proposed classification of value theories is as follows: A. *Subjective theories:* (1) Affective. Value consists in feeling aroused by an object. (2) Volitional: Value consists in desire for an object. (3) Affective-volitional: Value consists in interest in an object. B. *Neutral theories:* (1) Value is a quality of objects as related to subjects, conditioned by judgment. (Dewey) (2) Value is a determination of the subject-object situation. (Alexander) C. *Objective theories:* (1) Value is an indefinable predicate, apprehended (a) by feeling—having a presentational function; (b) by judgment. (2) Value is a relation among objects. (3) Value is an "objective."

To subjective theories generally it is objected that "whether or not there is a sense in which we value without judging, at least we discover no *values* except through judgment; hence the subjective attitude assigned always presupposes a judgment—unless, indeed, it can be maintained that there is emotional as well as cognitive apprehension, and that value is a content emotionally presented"; but, "feeling, though a common accompaniment of the value judgment, is merely incidental to the valuing." Neutral theories "illustrate the difficulty of distinguishing the content from the activity of valuing so long as we retain the psychological point of view, from which value seems to be necessarily value *for a subject.* It is only when we raise the logical question: are the objects which we value really *valuable,* and by what standard can we evaluate them?—that we recognize that no analysis of subjective activities sheds any light upon the real problem at issue." The following passage well epitomizes the argument of the book as a whole: Value "cannot consist in the affective relation of subject to object, for the specific character that distinguishes so-called 'value feeling' from other affective states is simply its association with a judgment of value, whilst the same *petitio principii* is involved in the attempts to trace it to interest or desire, which are only related to it at all inasmuch as they commonly include this feeling, and so presuppose the judgment which it accompanies. The judgment itself cannot, however, be constitutive of the value, for value is not a particular that is brought into being through an act of judging or any other mental process. Though usually predicated of the actual, it may apply equally to the possible. Again, the theory that professes to avoid the disadvantages of both subjective and objective views by treating value as a subject-object determination is found to combine two inconsistent positions, one of which is open to the same objections as other relativist theories. Once it is perceived that its reality does not depend upon a subject, however, it becomes apparent that it must be apprehended, like other objective determinations, intellectually, for, even if "emotional presentation" be a genuine mode of experience, it can give us no criterion of validity; hence we require judgment to distinguish genuine from illusory values, i.e., to be certain that what is presented, or apprehended, is value at all. Lastly, the view that it is a relation between objects themselves is always found either to resolve it into something that is clearly *not* value, or to presuppose it in the objects related, whilst the theory that it is a unique type of objectivity seems to have little meaning, unless this be made to coincide with reality in the broadest sense, whilst even then it has too little connotation to describe a concept which, though admittedly *indefinable,* is by no means *indefinite* in its significance."